164

PV.

VOLUME II.

TRANSCRIPT OF RECORD

469281

2.C.

SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1941

No. 265

FEDERAL POWER COMMISSION AND ILLINOIS COMMERCE COMMISSION, PETITIONERS

vs.

NATURAL GAS PIPELINE COMPANY OF AMERICA AND TEXOMA NATURAL GAS COMPANY

No. 268

NATURAL GAS PIPELINE COMPANY OF AMERICA AND TEXOMA NATURAL GAS COMPANY, PETITIONERS

vs.

FEDERAL POWER COMMISSION AND ILLINOIS COMMERCE COMMISSION

ON WRITS OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT

Petitions for certiorari filed July 12, 1941, July 14, 1941

Certiorari granted October 13, 1941

IN THE

United States Circuit Court of Appeals
For the Seventh Circuit

No. 7454

NATURAL GAS PIPELINE COMPANY OF AMERICA
AND TEXOMA NATURAL GAS COMPANY,
Petitioners,

vs.

FEDERAL POWER COMMISSION AND ILLINOIS
COMMERCE COMMISSION,
Respondents.

Petition for Review of Interim Order of the Federal Power Commission.

INDEX.

Petition of the Illinois Commerce Commission, filed with the Federal Power Commission, September 23, 1938 1

Order of Federal Power Commission instituting Investigation, entered October 14, 1938..... 6

Answer of Natural Gas Pipeline Company of America and Texoma Natural Gas Company to Petition, filed November 16, 1938..... 9

Order fixing date of hearing, entered April 14, 1939..... 13

PROCEEDINGS AT HEARING.

Statement by Examiner..... 15

Statement by Mr. Morgan..... 16

Colloquy 25, 33, 64

Statement by Mr. Booth..... 28

Statement by Mr. May..... 31

ABSTRACT OF TESTIMONY.

Witnesses for Federal Power Commission.

Testimony of:

Brown, Claude C.....35, 36

Knapp, Charles W., Jr.....2004, 2103, 2588

Smith, Charles W.....2041, 2322, 2632

Witnesses for Illinois Commerce Commission.

Testimony of:

Kleinman, Fred 2075, 2382

Ostrander, E. D.....1977, 2277

Woodford, John M.....57, 393

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1976; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3902; Vol. VIII, pp. 3903 to 4023.

Witnesses for Defendants.

Testimony of:

Biddison, P. McDonald.....1041, 1284
Brainard, W. F.....481
Brown, Floyd C.....491, 1311, 1636
Bulla, W. T.....987
Bussard, R. M.....715, 854, 1056
Campbell, S. E.....1003, 1398, 2554, 2637
Cooke, John A.....1446, 1909, 2616, 2669
Cottingham, V. E.....187
Davidson G. M.....1013, 1040, 1068, 1142
Davidson, W. H.....815
Delafield, Robert H.....1415, 1753, 2558, 2657
Dickinson, J. G.....613, 874, 1379
Dorau, H. B.....1512, 1636, 1788, 1965, 2527
Eastman, H. L.....1210
Emery, J. A.....1324, 1451, 1638, 1690, 1927
Foster, M. E.....1110
Galloup, Charles I.....453
Gill, Stanley.....361, 1024
Gillman, William C.....
.....1471, 1678, 1702, 1867, 2469, 2600, 2671
Hamilton, F. C.....1191, 1271
Hammerschmidt, E. G.....465
Hughes, C. Don.....315
Kesinger, E. V.....647, 2596
Miller, S. L.....1340, 1383
Palyi, Melchoir.....398
Parker, R. D.....249
Peterson, C. J.....192, 359
Powers, R. T.....767

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1976; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3900; Vol. VIII, pp. 3903 to 4023.

Testimony of:
Smith, W. D. 1119
Solow, E. M. 1167, 1859
Stoddart, Frank W. 1259
Strong, R. G. 903
Taubman, Herman P. 1148, 1190
Thompson, J. D., Jr. 275
Wallace, R. J. 1341
Willard, J. L. 1240
Zwiener, K. V. 1367

EXHIBITS.

No.
3 Production and B.T.U. by Fields Texoma Company for year ending June 30, 1938 (F. P. C.) ..2673
4 Gas sold or delivered, Texoma Company for year ending June 30, 1938 (F. P. C.) 2674
5 Texoma Company Consolidated Operating Analysis, etc. (F. P. C.) 2675
6 Texoma Company earnings analysis, 1934 to 1938, inc. (F. P. C.) 2676
7 Natural Gas Company gas sold or delivered by companies for year ending June 30, 1938 (F. P. C.) 2677
8 Natural Gas Company report of purchased gas and cost, 1934 to 1938, inc. (F. P. C.) 2679
9 Natural Gas Company consolidated operating analysis of gas purchases and sales, 1934 to 1938, inc. (F. P. C.) 2681
10 Natural Gas Company Sales and Revenue, 1934 to 1938, inc. (F. P. C.) 2683
11 Natural Gas Company Sales Agreements on file with Federal Power Commission (F. P. C.) 2685

No.	Exhibits.	
14	Map showing delivery points and Natural Gas Transmission Lines (F. P. C.)	2687
15	Natural Gas Company and Texoma Company Earnings Statements, Calendar Years to December 31, 1938 (I. C. C.)	2689
28	Natural Gas Reserves — Texas Panhandle (Defts.)	2756
36	Natural Gas Reserves — Texas Panhandle (Defts.)	2757
41	Natural Gas Reserves — Texas Panhandle (Defts.)	2759
43	Explanation of Reserve Calculations (Defts.)	2760
44	Details of Reserve Estimate Marginal Gas Acreage—Texas Panhandle Field (Defts.)	2767
53	Errata—Exhibit No. 15 (I. C. C.)	2771
54	Natural Gas Company and Texoma Company Balance Sheets, December 31, 1934 to 1938, inc. (I. C. C.)	2771
78	Picture showing assembly of two 18-inch gas lines upon a suspension bridge across Big Blue River in Moore County, Texas (Defts.)	2783
79	Two photographs: Canadian River crossing in Hutchinson County, Texas, and typical manifold for submerged river crossing (Defts.)	2785
84	Map showing distances of Panhandle, Michigan and Illinois Fields from Chicago (Defts.)	2787
85	Photographs of Scenes at Pipeline Break near Sheffield, Illinois (Defts.)	2789
86	Statement of Open Flows and Rock Pressures on Date Wells were abandoned. Eldorado & Augusta Fields—Butler County, Kansas (Defts.)	2801

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1976; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3902; Vol. VIII, pp. 3903 to 4023.

No. Exhibits.

92 Picture of Compressor Station No. 1 (Defts.)...2803
114 Regulatory Expense (Defts.).....2805
116 General Expense, Taxes, New Business Expense (Defts.).....2806
117 Summary of Additional Capital Expenditures and Operation and Maintenance (Defts.).....2819
122 Salvage Value as of December 31, 1954 (Defts.).2841
Non-Salvageable Property not listed in Exhibit 122 1143
123 Picture Showing Interior of Fritch Station and 12 Engines (Defts.) 2907
124 Errata Sheets for Exhibit 122 (Defts.).....2911
125 Volumes I and II of Valuation (Portions of) (Defts.) 2922
129 Personnel Data—Key men in Chicago Office, etc. (Defts.) 2927
130 Cost of Attaching Business (Defts.).....2943
131 Market Value of Leases (Summary Sheet) (Defts.) 2947
132 Quotations and Yields of U. S. Treasury Notes and Bonds at Close of Market on August 15, 1939 (Defts.) 2951
133 Average Yield obtainable from Investments in U. S. Notes and Bonds (Defts.).....2953
134 Explanation of Method Used in Determining Reserves as of 8/1/31, on Acreage owned by Texoma 1/1/39 (Defts.).....2955
136 Earnings Statements for Calendar Years 1932 to 1938, inclusive (Defts.).....2958
137 Balance Sheets and Statements of Plant and Equipment December 31, 1931 to December 31, 1938, inclusive (Defts.).....2989

No.	Exhibits.	
138	Statement of Operating Revenue and Expenses, etc. (Defts.)	3003
140	Earnings Statement covering entire life of Project (Defts.)	3021
141	Earnings Statement based on Book Cost as of January 1, 1939 (Defts.)	3025
142	Earnings Statement based on Reproduction Cost new less existing depreciation as of June 1, 1939 (Defts.)	3029
145	Reconciliation of Statement Included in Exhibits 136 and 15 (Defts.)	3033
146	Texoma Natural Gas Company Summary of Market Value of Leases (Defts.)	3069
147	Natural Gas. Co. and Texoma Co. Data concerning Rate of Return, etc. (Defts.)	3071
148	Natural Gas Co. and Texoma Co. Data concerning Rate of Return—Year 1938 (Defts.)	3079
149	Estimated Earnings on Account of Increased Capacity and Delivery of Natural Gas when operating at Higher Pipe Stresses (Defts.)	3105
150	Natural Gas Co. and Texoma Co. Data concerning Rate of Return (Defts.)	3106
151	Photostat of Investment Treatises (Defts.)	3123
152	Natural Gas Co. and Texoma Company Data concerning Rate of Return (Defts.)	3141
154	Article by Paul Ryan, "The Natural Gas Industry an Expanding Service" (F. P. C.)	3305
155	Facing Sheet and Pages 4 and 5 from 1st amendment to Registration Statement of Public Service Co. of Colorado, filed with S. E. C. 12/10/38 (F. P. C.)	1880, 3314

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1975; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3902; Vol. VIII, pp. 3903 to 4023.

No. Exhibits.

156 Certified copy of Gallagher's Exhibits 2 and 2A covering estimate of Investment and Anticipated Average Annual Net Earnings relative Docket 21170 before Illinois Commerce Commission (I. C. C.) 3320

Exhibit 2—Estimate of Investment in Facilities for Production of Natural Gas in Texas, etc. 3321

Exhibit 2A—Revised page 1 of Exhibit 2... 3333

157 Certified copy of Gallagher's testimony before Illinois Commerce Commission in connection with Exhibit 2 of Commerce Commission and covering Pages 12 to 99, inc. of record in case No. 21170 (I. C. C.) 3335

158 Facing Sheet and Page 62 from 1st amendment to Registration Statement of Public Service Co. of Colorado filed with S. E. C. 12/10/38 (F. P. C.) 3374

159 Facing Sheet and Pages 5 and 6 from Registration Statement of Public Service Company of Colorado filed with S. E. C. 8/30/39 (F. P. C.)... 3379

160 Facing Sheet and Page 57 of Registration Statement of Public Service Company of Colorado filed with S. E. C. 8/30/39 (F. P. C.)..... 3385

161 Release No. 1667 of S. E. C. under Holding Company Act containing findings and opinion re Northern Natural Gas Co. (F. P. C.)..... 1884, 3390

162 Letter of Ralph E. Davis, Inc. to Northern Natural Gas Co. dated 6/1/39 re Natural Gas Reserves (F. P. C.)..... 1885, 3401

No.	Exhibits.
163	Pages 8, 9, 10 from Registration Statement filed with S. E. C. by Panhandle Eastern Pipeline Co. covering Ralph E. Davis Production Property and Gas Reserves (I. C. C.) 3408
167	Exhibit 49 in case of Chgo. District Pipeline Co. v. Lindheimer, et al., comparing present market price of issuance of Natural Gas Bonds (F. P. C.) 3413
168	Poor's Public Utility Volume 1939—Pages 164-167, inclusive (F. P. C.) 3419
169	Pages a55 to a61, inclusive of Moody's Manual of Investments 1939 (F. P. C.) 3428
170	Page 250 from American Gas Association Monthly, August, 1939, "Expanding Markets for Gas Industry Make Investments Sound," by P. S. Young (F. P. C.) 3458
171	Pages 19-20-37 from "Gas"—July, 1939, article by Percy S. Young entitled "The Investment Attributes of Gas Utility Securities" (F. P. C.) 3460
172	Pages 251-255 of American Gas Association Monthly issue of July-August, 1939, article, "A Banker Analyzes Natural Gas Industry Investment Values," by Frank R. Denton (F. P. C.) 3468
173	Pages 37, 38, 43 of "Gas," May, 1939, issue, article, "A Stock Broker Analyzes the Natural Gas Industry," by John Nickerson III (F. P. C.) 3471
174	Pages 56-61, incl. from 1939 Autumn issue of "The Index" article, "The Gas Industry" (F. P. C.) 3477

No. Exhibits.

176 Pages 253-255, incl. from issue of July-August, 1939, of American Gas Association Monthly article, "The Fifth Big Job," by Charles R. Bellamy (F. P. C.) 3486

178 Pages 24-33 from January, 1939, issue of "Gas" article, "The Natural Gas Industry Provides Opportunities for Investment," by James S. Carroll (F. P. C.) 3492

179 Statistical Bulletin No. 37 of American Gas Association dated October, 1939, entitled "Annual Statistics of the Natural Gas Industry in 1938" (F. P. C.) 3496

180 Trends of Interest Rates and Bond Yields (I. C. C.) 3523

181 Summaries of Recent Financing by Natural Gas Systems (I. C. C.) 3535

182 Computations in Regard to the Sinking Fund Method of Amortization and Rate of Return on Net Investment (I. C. C.) 3553

183 Money Market Factors (I. C. C.) 3559

184 Exhibit 20, entitled "Details of Items of Expense in Operation of a Single Pipe Line from Texas to Joliet, Illinois and certain misc. data," in Peoples Case before Ill. Comm. Com. No. 21170 (I. C. C.) 3567

185 Rate of Return Study—Part I (F. P. C.) 3576

186 Rate of Return Study—Part II (F. P. C.) 3724

187 Comparative Statement of Combined Profit and Loss for 8 months ended August 31, 1939 and 1938 (I. C. C.) 3784

No.	Exhibits.	
188	Proforma Comparative Balance Sheets Annually at Dec. 31 from 1939 to 1954 and after liquidation (I. C. C.)	3785
191	Revision of Chart 8 and Supporting Schedule No. 12 in Exhibit 185 (F. P. C.)	3841
192	Revision of Chart 10 and Supporting Schedule No. 14 in Exhibit 185 (F. P. C.)	3849
193	Revision of Chart 11 and Supporting Schedule No. 15 in Exhibit 185 (F. P. C.)	3855
195	Revision of Chart No. 12 of Exhibit 185 (Defts.)	3859
196	Revision of Chart No. 14 of Exhibit 185 (Defts.)	3863
197	Study of Yields at Market Prices of Electric Operating Utility Preferred Stock and number of times dividend and prior requirements are earned, Based on Market Prices for week ended Nov. 17, 1939—Income for latest 12 months (F. P. C.)	3867
198	Earnings—Price Ratios of Electric Operating Utility Common Stocks and Per Cent of Gross Income available for common stocks, market prices for week ended Nov. 17, 1939, annual income from latest quarterly reports (F. P. C.)	3869
201	Photostat of Voucher 55810 (6/21/38) $5105.15 to Ralph E. Davis, Inc. (F. P. C.)	3871
202	Data on Sales, Revenue and Customers—Peoples Gas Lt. and Coke Co. (Defts.)	3877
203	Residential Electric Service in United States (Defts.)	3885
204	Commonwealth Edison Co. (Customers, Consumption, Revenue, and Rate) (Defts.)	3885

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1976; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3902; Vol. VIII, pp. 3903 to 4023.

No. Exhibits.

205 All Mortgage Bonds of Domestic Electric and Gas Utility Companies traded on New York Curb September 15, 1939 (Defts.) 3886

206 All Preferred Stocks of Domestic Electric and Gas Operating Utilities paying full dividends Listed N. Y. Curb (Sept. 15, 1939, Prices) (Defts.) 3888

207 Gross Operating Revenue and Total Net Available for Fixed Charges After Depreciation of the Gas Departments of the Three Utilities Distributing Gas in the Chicago Area (Defts.) 3891

208 Gas, Electric and Telephone Utility Companies serving City of Chicago (Defts.) 3893

209 Bonds, Debentures and Notes of Natural Gas Companies holdings by public (Defts.) 3895

210 Revision of Page One in Exhibit No. 141 (Defts.) 3901

211 Revision of Page One in Exhibit No. 142 (Defts.) 3902

Motion for Interim Order reducing rates, filed November 7, 1939 3903

Defendants' Pleas to Jurisdiction and Reply to motion for Interim Order filed December 18, 1939 3914

Conditional Answer to motion for Interim Order, etc., filed Dec. 18, 1939 3920

Memorandum Opinion, filed July 23, 1940 3925

Order reducing rates, entered July 23, 1940 3942

Motion for stay of order of July 23, 1940, filed August 8, 1940 3947

Objections of Illinois Commerce Commission to motion for stay of order, filed August 9, 1940 3958

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1976; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3902; Vol. VIII, pp. 3903 to 4023.

Order granting in part and denying in part motion for stay of order of July 23, 1940, entered August 8, 1940 3960
Application for Rehearing, filed August 16, 1940 3961
Order denying Rehearing, entered September 6, 1940 .. 3993
Certificate to Record 3994

PAPERS FILED IN U. S. COURT OF APPEALS.

Petition for Review, filed September 11, 1940 3997
Statement of Points 4009
Stipulation as to Printing 4020
Supplemental Stipulation as to Printing 4022

I

Order staying order of Commission 4025
Opinion, Evans, J 4026
Judgment 4041
Clerk's certificate 4042
Orders allowing certiorari 4043

Vol. I, pp. 1 to 646; Vol. II, pp. 647 to 1310; Vol. III, pp. 1311 to 1976; Vol. IV, pp. 1977 to 2672; Vol. V, pp. 2673 to 3031; Vol. VI, pp. 3033 to 3417; Vol. VII, pp. 3419 to 3902; Vol. VIII, pp. 3903 to 4023.

471 E. V. KESINGER, a witness for defendants, testified as follows:

Direct Examination by Mr. Morgan.

(July 24, 1939.)

My name is E. V. Kesinger. I live in Highland Park, Illinois. I am general superintendent of Natural Gas Pipeline Company of America and Texoma Natural Gas Company.

I graduated from Kansas State College with a B.S. degree in electrical engineering in 1917.

In June of 1917 I was employed by the Empire Companies of Bartlesville, Oklahoma. My first job was in a repair crew of a gas compressor station at Big Heart, Oklahoma. With the exception of the time that I was in the army, I remained with the Empire Companies until I joined the Continental Construction Corporation, the predecessor of the two companies with which I am now employed, in June of 1930.

While in the army, I was in the infantry for a few months, following which I went into the artillery officers' training camp and was commissioned as second lieutenant. My army service extended from October, 1917, until May of 1919. Following my discharge from the army I returned to the general engineering department of the Empire Companies at Bartlesville, Oklahoma, in July of 1919.

The Empire Companies of Bartlesville, Oklahoma, operated a general engineering department that performed and designed engineering and construction work for a number of affiliated Empire Companies. During the latter half of 1919 and the year 1920, I was in this general engineering department, during which time I was doing general clerical and engineering work.

In the year 1921 I was made resident engineer in charge of construction and oil refinery that the Empire had at Ponca City, Oklahoma. While at Ponca City I also supervised the construction of an oil pump station at Arkansas City, Kansas.

In the beginning of 1922 I returned to the general engineering office of the Empire Companies at Bartlesville. About the middle of 1922 I was a member of a party of three engineers delegated to investigate and make a valuation of some refinery and other properties owned by the New England Oil & Refining Company, Fall River, Massachusetts. When this work was completed I returned to the general engineering department of the Empire Companies

at Bartlesville. I spent the remaining portion of 1922 and the year 1923 in the Bartlesville office, concerning myself with the design of various facilities pertaining to refineries, oil pump stations, gas compressor stations, and oil pipe lines.

472 In the year 1924 I was resident engineer in charge of construction work at the refinery that the Cities Service Company had purchased at Fall River, Mass. This work consisted of rearranging a number of facilities in the plant and the installation of two cracking units. That was the same property that I had been assigned to examine and value a couple of years before. Following our valuation the negotiations to purchase consumed considerable time, and when Cities Service finally bought the property I was delegated as the engineer in charge to rearrange the facilities and install the cracking units and start the plant up. That work required the year 1924, and upon its completion I returned to the general engineering department of the Empire Companies at Bartlesville.

During the years 1925, 1926 and 1927, I remained in this general engineering department, during which time I was occupied with the development of design and the supervision of construction of various facilities and properties for the Empire Companies. This work involved oil refineries, gas compressor stations, gas pipe lines, oil pipe lines, and oil pump stations.

The main project on gas properties that was carried out in 1927 was the construction of 250 miles of 20 inch gas pipe line from Pampa, Texas, to Wichita, Kansas, and as I recall, there were about three compressor stations on the line. There was also involved the construction of a complete field gathering system to go with the project. That gathering system was down in the Texas Panhandle, and it is now the gathering system operated by the Cities Service Gas Company. This 20 inch line from Pampa, Texas, to Wichita, Kansas, was later extended to Ottawa, Kansas, by the construction of 122 miles of 20 inch pipeline. I supervised the development of the design and supervised the construction of the extension, the same as I had the original line from Wichita to Pampa, Texas.

During the years 1928 and the early part of 1929, a large part of my time was used in investigations in regard to the location of a refinery and the development of the designs to be used and employed during the construction of this refinery. This plant is now in operation by the Cities Service Oil Company at East Chicago, Indiana.

During the period that I was concerned with gas and oil

properties, running from 1923 to 1929, I supervised the design or supervised the construction of over 1800 miles of oil and gas pipelines.

About the middle of 1929 I was relieved of my routine duties that I was carrying on for the various Empire Companies, and told to prepare myself for the construction of a major gas pipeline. We had various matters that we wanted to investigate before we built another project of that type. I understood in general at that time that this was to be a pipe line constructed under the guidance of Henry L. Doherty, and that it would run from the Texas Panhandle to the Chicago area.

As the result of a large amount of oil and gas pipeline work that I had been supervising for the Empire Companies, there were a number of facilities that we wanted
473 to improve before we launched another project of this type. Consequently I concentrated my time on the investigation of some of these problems and I also supplemented my own efforts with a corps of engineers.

A few of the things we wished to investigate were that we wanted to perfect a better gate valve for use in gas pipelines. We were not satisfied with the design and the type of couplings that were then on the market for use in gas pipe lines, and we wanted to improve this facility. We also wanted to work out the fabricating designs for the construction of river headers and drips and other facilities that involve the use of fabricated pipe in gas pipeline projects.

We were not at all satisfied with the control methods and the procedures available for the use of electric welding and acetylene welding and applying these two methods for the construction of gas pipe lines in the field. We wanted to investigate the properties of some of the coatings that were then on the market and supposed to have the property of protecting underground pipe lines. We also wanted to perfect means of standardizing and controlling the application of these coatings to obtain better results with them.

Above all, we wanted to press for a better quality pipe that would be commercially available and would have uniform dimensions, uniform properties, so that we could build a more reliable gas pipe line.

We also investigated various compressor stations that had been constructed in the Midcontinent field by other gas pipeline companies. This compressor station work was done by other engineers under my supervision.

I personally visited many of the midcontinent pipe lines and some of the gas pipe lines on the west coast for the pur-

pose of learning of any developments in regard to the design or the laying of the gas pipe lines that might have been brought about by these other companies.

We also carried on and continued our efforts to find out or understand the peculiar phenomena that caused the formation of solids in gas pipe lines under certain pressure conditions. These solids are now known as gas hydrates, and that is the same phenomenon that Mr. Hammerschmidt testified about here, and also Mr. F. C. Brown. Mr. Hammerschmidt was one of the engineers involved in that investigation work while we were on the properties of the Empire Companies; but it was not until after Texoma Natural Gas Company had been formed and Mr. Hammerschmidt transferred to that company that we finally developed the theory that disclosed to us the real phenomena that brought about the formation of these solids and enabled us to handle them in better fashion.

When I was assigned to this work I have just been outlining, I do not recall that anything was said to me about the pressures at which this contemplated line would be operated; but we had been working for years trying to get into a position of utilizing steel at higher stresses and, 474 of course, one way of accomplishing that would be to operate the pipe line at higher pressures, and I had been a member of the group of engineers that had been discussing this phase of the matter for some time. As a matter of fact, late in 1929 or early in 1930, we constructed about ten miles of 24 inch gas pipe line in which we incorporated some of the theories and principles that we had been developing simply to check where we were with the development work, trying out in practice the principles which we thought we had evolved from the theoretical standpoint.

We had different kinds of pipe in that line. We wanted to find out what problems there were in welding, how it would act after it was welded, how it would handle in the field, and various things about it that we wanted to know as to how it would be from a practical viewpoint in addition to a theoretical viewpoint.

I have said that we wanted to improve the quality of the pipe that was being used in the operation of gas pipe lines. We had been using lap welded pipe in the construction of gas pipe lines. This pipe came in short lengths. We wanted, if possible, to obtain pipe in longer lengths in order to eliminate field joints and decrease the cost of the completed line. We also wanted a pipe that was more

uniform in its dimensions. Lap weld pipe has a tendency to run overweight or underweight, or it will be thick at one end and thin at the other end. The main defect in the lap welded pipe was the erratic nature and inefficiency of the longitudinal seam that runs through this pipe.

Also we were constantly pressing the pipe manufacturers for pipe of larger diameter, and due to the particular way this pipe is made they were handicapped in manufacturing the wall thickness that we wanted as the diameter increased. The tendency was to supply us with pipe of heavier wall than we wanted.

The objection to having the heavy wall pipe or a thick wall pipe from the standpoint of one who is contemplating the building of a pipe line is that we wanted to work the steel in this pipe at a safe stress, but we wanted to be able to work it uniformly at that stress and we did not want any excess weight in the pipe unless it was accomplishing some good.

The objection to that was that this pipe was costing us in the neighborhood of $100 or $103 a ton. Besides the cost of the pipe you have the extra cost of handling it in the field, and you have the extra cost of welding it. To illustrate, if the wall thickness was running 25% heavier than it need be from a stress standpoint, the final cost of the line was affected materially by the extra weight that was in the wall of the pipe, both by extra tonnage and by extra cost of handling in the laying of the pipe line.

I had a corps of engineers under me varying in number, but occasionally running up in the neighborhood of fifty, and we were concentrating on these various problems the last half of 1929 and all of 1930, and a few of them carried over into 1931, and the hydrate followed even later than that.

475 *Questions by the Examiner.*

At this time I was not stationed at any one place. I was in New York occasionally during that period. Between the middle of 1929 and the middle of 1930 I was in New York a number of times. I was working during that year out of the Bartlesville, Oklahoma, office and out of the New York office. I was actually spending an awful lot of time in aeroplanes and on trains, and I had engineers at various points working at different things.

The Examiner states that there has been some suggestion of studies and reports made and submitted at this time, and inquires whether I am familiar with that. I know

about those matters in general. As I recall the testimony, it pertained to reports that started in 1926. This matter of building a gas pipe line from the Texas Panhandle to Chicago was suggested by Mr. Henry L. Doherty back there sometime. From 1926 on the Empire Companies had a group of engineers that did make analyses, geological studies, and calculations that were directed toward determining whether or not this project was feasible. I was not a member of that engineering group or that particular body of men. During those years I was quite busy spending money, rather than pushing a pencil, and the engineers that made those earlier estimates were a separate group that were used almost entirely for investigating the feasibility of various projects, not only the line to Chicago, but there were many studies made back through those days based on various size lines and various pressures and all kinds of combinations for both oil and gas lines.

As to whether there would be a number of groups studying different problems and each group would do its own calculating, as I recall, the men who were making these studies varied in number from four to twelve, and they were usually working on some oil pipe line project, and when they got that report done there would be some other suggestion, "let's investigate this pipe line project," and this next time it might be three or four weeks' work or it might be a month's work at some refinery.

Take, for instance, this location of the Cities Service Oil Company refinery out here at East Chicago. That plant had ahead of it many reports. There was a group of engineers that investigated the freight structure, breaking points and freight rates, etc., and there was another group of engineers that investigated the market outlets. By that I mean what market outlets Cities Service might be able to acquire or control. Those theoretical things were carried on by other engineers. By that I mean a coordinating group of engineers who called on the other groups for certain results.

In the case of the refinery problem, part of the refinery staff of the Empire Companies was in Tulsa, Oklahoma. The engineering part of that staff was in Bartlesville, Oklahoma. As far as markets were concerned, the information would have to be compiled in Tulsa and come up to the engineers in Bartlesville, who were dealing with freight rates

or dealing with costs of pipe lines or matters of that
476 kind. I was not involved in that problem until they had reached the point that they had concluded that there

was an economic possibility of locating an oil refinery in one of these northern areas and building an oil pipe line up here.

I feel quite sure there is no tendency to keep a library of such studies. I know we do not do it even in our current work. We make the study to get the answer, and having obtained the answer, we usually do something about it and then we have the property, and I personally do not keep for any very long period theoretical analyses of things of that kind that are done for me. I either use them or discard them, and if I use them I do no longer need them.

Direct Examination by Mr. Morgan Resumed.

We started constructing the line in August, 1930, and by that time we had some of these things perfected and some of them were not perfected. I was made chief engineer of Continental Construction Corporation in June of 1930. In that position I was to report direct to Mr. Floyd C. Brown, who was to be vice president and general manager of the corporation, and I was to have charge of the selection of the personnel, the development of the field surveys, the securing of bids, the contracting of the construction of the property, the development of the design, and the drawings that might be necessary in the purchase of materials. I was to have charge of the inspection of the materials as they were manufactured, to have charge of the field construction work, inspection of that construction work, and I was to have charge of the cleaning and the purging and testing of the line.

My title at that time was chief engineer. I continued as chief engineer in charge of construction for the Continental Construction Corporation until January 1, 1932. In the meantime, the name of Continental Construction Corporation had been changed to Natural Gas Pipeline Company of America on December 10, 1931. Texoma Natural Gas Company was organized May 26, 1930, and I was made chief engineer of that company when it was organized. I continued as chief engineer of both of these companies during the period of construction until January 1, 1932.

At the time I was made chief engineer of these companies and charged with the several duties I have mentioned in connection with the planning, designing and construction of this pipeline and its various properties, it was not known to me that I would become general superintendent of these

two companies. The original discussion was confined to the design and construction of the line, and nothing was said to me as to whether or not I would be involved in its operation or who would operate it.

I have referred to field surveys, the designing of materials and other work of design, the making of specifications, etc. We had constructed a line from Pampa, Texas, to Wichita, Kansas, and had some knowledge of the Panhandle field due to our experience down there in 1926 and 1927.

We were also fairly familiar with the general territory
477 in the Texas Panhandle, the Panhandle of the State of Oklahoma, and the State of Kansas, but these field surveys were necessary in order to secure detailed information on certain control points, such as river crossings, or anything else that might result in difficulties during construction or might result in heavy maintenance after the line was constructed, or might prevent the restoring of service promptly after it was constructed.

These field surveys were sometimes made by civil engineers and sometimes by pipe line engineers or operating men. It depended on the nature of the problem. We went to the points we suspected as being dangerous or difficult to handle and collected whatever information we needed to guide us as to whether or not we wanted to cross there, or wanted to try to cross there, or whether we wanted to look for some other place. That problem had to do with the general location of the line, the general course of the routing, and that work was done under my supervision.

The field surveys were made by men under my direction, these being pipe line men or civil engineers that I had known or had used in other jobs. After the general scouting of some of these control points was completed, we went to work on the United States topography maps. We sketched the general course of the line on these maps and made a very careful study of the difficulties that would be encountered, judging the situation from contours.

After the general contours had been worked out on these topography maps, we then had aerial surveys made of the more important points on the line, particularly the Missouri River and the Mississippi River, and the Canadian River, and features of this kind. We had separate aerial surveys made of quite a stretch up and down the rivers. After these aerial surveys were in we were able to study the question more completely and make a more definite lo-

cation as to where we would want to cross some of these hazards.

Having the general location of the line and having made sure that the various control points were worked out with a degree of nicety, we then proceeded and had an aerial survey made of the entire suggested location. We wanted this aerial survey to check our judgment as to the location of the line in total, and we also wanted to use the aerial survey as the base map in our various construction activities, such as contracts, etc. I worked out this field survey and made the final recommendation to Mr. Brown and the management as to the final location of the line.

When we started out to determine upon the location of the line we had in mind that we were starting to serve a major market that would be approximately 900 miles from the field or the source of supply of the gas, and consequently continuity of service was always emphasized and stressed. Also we wanted the location to be such that we would have the cheapest line not only from the standpoint of its original cost but from that of the over-all cost, including the operation and maintenance of the line, and we were careful in locating the line to so locate it that it could be so maintained.

The pipeline was built along the line which I selected 478 and recommended to the general manager, with certain minor changes in the location in areas and certain little variations in some detail. We frequently found it necessary to change the general course of the line maybe a mile or half a mile, or some such matter as that, in order to miss farms where we were unable to purchase rights of way. Those were just minor changes that were made from time to time to take care of those local features or handicaps that we were unable to overcome.

Afert having made my recommendations as to the location of the line, it became necessary to me, as chief engineer of the project, to assemble an organization to carry out these functions. Obviously, I did not perform all of them myself. The thing we had to get done was to develop designs and drawings where they were necessary for the securing of bids for the furnishing of material. When these matters were ready they were submitted to the various manufacturers in order to secure competitive bids for furnishing the quantity of material and the quality that we required.

The major items included in the material would cover

such things as 24 inch pipe, 18 inch pipe, 16 inch pipe, pipe of smaller diameters, the coating for that pipe, 24 inch main line gate valves, couplings for the 24 inch line, buildings for the sales meters and for the various functions in the gas compressor stations, the main compressor units to be installed in the compressor stations, the auxiliary gas engine driven electric generators to furnish electricity for light and power for the compressor stations, various machine shop equipment to be used in the stations, etc. That is not one-hundredth of them, but those are the main ones.

All of those things and other material that went into the construction of this pipe line were purchased on specifications. We did not just go to the manufacturer of pipe and tell him we wanted so many feet and so many tons of pipe of a certain dimension. It depended on what the material was, but in many cases we not only prepared specifications but we made drawings or designs, and along with these drawings we wrote specifications, and when these were assembled we submitted them to various manufacturers and asked them for their prices. This would apply to such things as fabricated river headers, drips, fabricated piping to be used around stations, etc.

Fabricated materials, in the way that I use that term, refers to the taking of one or more materials as they come in their natural state from the original manufacturer and by cutting or assembling you make these materials into a unit of a different kind. For instance, in the fabrication of a river header you would obtain pipe of two or three different sizes and various lengths and you cut this material into the proper lengths. You would obtain welding heads, welding pipe saddles, nipples, valves, etc., and by assembling these various pieces in the proper manner you would eventually fabricate a river header.

We had other things to do in addition to designing the material of the various units of pipe, machinery, etc., which was to be utilized before we could construct a pipe line.

479 We had to obtain the rights of way upon which to construct the pipeline. We pushed this right of way purchase activity along as fast as we possibly could. We had to purchase or make arrangements for purchase of all of the materials, some of which I have named. We had to prepare specifications, contract forms for obtaining bids from contractors for assembling these materials in the field. We had to inspect the manufacture of the materials. We had to arrange for the delivery of the materials to the

various contractors at the points where and when they were needed, and we had to inspect the execution of the assembly of these materials, the performing of the work in the field.

All of this work was coordinated. Naturally, some of the things preceded the other, and as fast as various phases of the work would clear up and the necessary items were coordinated, we would release the contracts.

I never did count the number of different contractors with whom we had contractual relations. The number of contractors bidding on the various kinds of work to be performed was quite large. Occasionally some of the work was sub-contracted. We controlled this feature of the contracts, and some of the work was sub-contracted and some of it was not. For instance, hauling was generally sub-contracted. In some cases we permitted the sub-contracting of welding, and there may have been other sub-contracts, but I have not refreshed my mind on these recently.

In those instances where our contractors let a part of their work to sub-contractors we were not relieved of our inspection duty. In fact, it did not change our relationship with the original contractor or his obligations to us. We held the general contractor liable for the contract even though he did sub-contract some of the work. Our inspection of the performance of the work was supplied in the field without regard to whether or not it was sub-contracted.

We found it necessary to do some work in determining with whom we ought to make contracts before letting these contracts. When this project was announced we were flooded with requests from contractors all over the United States that wanted to build pipe lines or build compressor stations or build the telephone line for us, and we soon found that it was going to be necessary for us to use extreme caution in the way we awarded these contracts. All of the contracts were to be awarded on competitive bidding, and we exercised the prerogative of submitting bidding specifications to contractors that we felt were qualified to build the pipe line proper, for instance, and we were careful to give bidding forms to contractors capable of building compressor stations when we were asking for bids on stations. The same principle was applied in the cottages and the telephone, and in the case of some rivers we guarded against the inclusion of contractors that were not qualified through experience and did not have the equip-

ment or personnel to perform the work that we scheduled in the contract.

We also concerned ourselves with the financial ability of the contractor to perform the size of contract that we were contemplating awarding. In other words, in so far as possible we wanted contractors bidding on the pipe line proper that had the personnel and the equipment suitable for
480 executing the work that was to be performed under that contract, and the same thing applied for the contractors bidding on the compressor stations or the telephone line or the cottage, or things of that kind.

I do not recall that there was any advertising of bidding except by word of mouth. The fact that this work was going on seemed to spread like wildfire, and the contractors were always crowding us to let them have the specifications.

However, after submitting the bidding forms to the contractors and receiving their bids for performing the work, we analyzed the bids to determine which contractor had submitted the lowest bid, and then we made a final check as to what work this contractor was performing for other companies and what equipment and personnel he had available. If the situation looked sound we submitted the data to Mr. Floyd C. Brown with our recommendation as to who should receive the contract.

(Statement by Commission counsel that testimony purely repetitions of Mr. Floyd C. Brown's and suggesting that Mr. Brown's testimony be adopted with reference to the above matters. Examiner permitted testimony to proceed.)

The specifications for material, for the construction of the line, and for the compressor stations and other properties were very detailed. They were very specific and very severe. The specifications pertaining to the construction of the field work, particularly the main 24 inch trunk pipe line, were considered so severe by at least one of the participating companies that they were fearful that the contractors would not accept the contract to operate under those specifications.

It has been stated that this pipeline construction work was let by sections to different contractors who contracted to build 80 or 100 or 120 miles of pipe line; but that does not mean that the contractors who obtained the contract to build a certain section of pipeline would build everything on the pipe line within that section.

We divided the main 24 inch transmission system into sections of various lengths, and then when we awarded the contract for the construction of a section, that contract would be confined to the construction of the 24 inch pipe line proper. If that section happened to include a compressor station, that would not be in the contract awarded to the pipe line contractor but would be in a separate contract awarded to another contractor to construct the compressor station. The dividing of the line into sections, and dividing the other facilities up into smaller units, enabled us to keep the size of those jobs such that we had ample competition in the competitive bidding. We guarded against having a pending contract that would involve sums of money that might restrict the bidding to one or two large contractors.

It also enabled us to prepare specifications that covered in detail and more specifically the contract work to be performed under that contract. For instance, 100 miles of the main 24 inch pipe line might contain no river. The next 80 mile section might contain two rivers: The specifications for the 100 mile section of pipe line would treat with the problems and features to be constructed in that section, and that same thing is true of the other sections.

481 *Questions by the Examiner.*

As to whether we let the river crossings separately or as part of our sections, the river crossings that were of sufficient size and required highly specialized equipment were separated out and awarded under separate contracts. That applies for the Missouri River and the Mississippi River. For the rivers that we crossed on the south end of the line, the type of work to be performed and the equipment required was not particularly different from what the usual pipe line contractor has, nor was it out of the ordinary line of work that he had been doing but in the case of the Missouri River and the Mississippi River the equipment required was entirely different. Those are submerged crossings. The only suspension crossing we have is the line across the Big Blue River in the Texas Panhandle.

Direct Examination Resumed by Mr. Morgan.

As these various contractors started executing the field construction work under the various contracts, we attempted to supervise the execution of this work by placing inspectors in the field at the points where this work was being performed. These inspectors were men selected for this particular duty and trained in the requirements of the specifications and the type of construction that we required. These inspectors were working under my supervision and direction.

We had rejections in the various plants over the country where this material was manufactured. As I recall, in gate valves we rejected about 4½%, of the compression cylinder heads about 12%, on 24 inch pipe the rejects ran quite heavy, particularly from Gary, Indiana, and McKeesport, Pennsylvania. At one time we had at least fifty miles of 24 inch pipe piled up in those yards rejected as not qualifying under our specifications.

The inspection of the field work was quite severe. The effective inspection was rather a heavy burden on all of the contractors, heavier than most of them expected. The result was that the work cost them more money than they anticipated. Three of the main pipe line contractors claimed that they lost large sums of money as a result of our inspection. One of the three sued us for about a million dollars.

I have stated that the actual construction of the pipeline was commenced in August, 1930. It was completed in August, 1931. By that I mean that we had the pipe in the ground, the pipe covered, and were up to the point of cleaning, purging and testing the line, and we had some of the station work fully completed and we had other station work yet to execute.

By cleaning, purging and testing the line I mean that regardless of the care that is used in laying a line, when it is finished it is advisable to free it of all foreign materials and remove the air, and to test the line to some elevated pressures. These materials that are in the line after it is completed are mill scale, sand, rabbits, dinner buckets and other items. The air and the foreign materials are removed by permitting gas to enter the pipe and allowing the gas to rush through a ten or twenty mile sec-
482 tion of the line, carrying these foreign materials and the air out.

After this is finished, you can apply pressure tests to that particular section or proceed to the next section and clean and purge that section and allow the pressure test to follow. As we completed the line it was tested at a pressure of 800 pounds. That high pressure was applied to this line in order to locate any structural weaknesses or defects and to enable us to operate the line more safely at the elevated pressure that we had in mind.

The compressor stations were being constructed as the pipeline was being constructed. We carried all of these operations on together, attempting to finish them in a coordinated manner; but at the time the pipeline was finished and we were testing the pipeline, the station work at some points was lagging materially, particularly at Station 1. That is the station owned and operated by Texoma Natural Gas Company at Fritch, Texas.

It was necessary to utilize these compressor stations in testing the pipeline under pressure. We did not need the compressor stations for the purpose of cleaning and purging the lines, but we did need them, or at least some of the engines in the stations, in order to supply the 800 pound gas with which we wished to test the line.

The compressor stations, of course, had to be cleaned of foreign materials and the air removed in the same manner as the pipeline, and we did this when the station work permitted, as we brought the pipeline pressure testing along. We also put pressure tests on all of the piping and facilities in the compressor station, and having arrived at this stage we were then confronted with the necessity of operating the main compressor units for the purpose of adjusting and balancing those units for the purpose of getting them in condition to carry their full rated horse power.

As a result of this testing of the pipeline and compressor stations we found some defects before the pipeline was put into permanent operation. In the case of the pipeline proper, we found a considerable number of minor defects. We also found one major defect. We had a point near Ford, Kansas, where the 24 inch pipeline failed, a joint of 24 inch pipe left the ditch, tore into several pieces, at a time when we had a gas pressure of 800 pounds on that section of the line.

The testing of the stations brought out a few minor defects and two defects that might be termed major. We

operated these units as much as we could and as soon as we could in conjunction with the testing of the line, but we did not accumulate many operating hours over any one main compressor unit before we learned that the gaskets in the exhaust valves were entirely unsuitable for the duty that they were to perform, and a little later we discovered that the design of the pistons in the power cylinders of these compressor units was faulty and the pistons started cracking on us after running from 50 to 600 operating hours.

The first piston failed, as I recall, about December 5, 1931, and it appeared to us at that time that this was a major defect, rather than just an accidental break of one piston. Consequently, we immediately contacted the manufacturer of the equipment and went into a lengthy investigation to determine the defect in the design we were using and how this defect could be corrected. It was about April of 1932 before we had the new design ready, and we then started obtaining new pistons from the manufacturer and proceeded to replace all of the pistons that were originally installed in the main units. We completed this piston replacement work on September 27, 1932. We had the main 24 inch pipe line tested from Station No. 1 at Fritch, Texas, to Joliet, Illinois, by August 28, 1931.

There was other work of that character which had to be done before we could put the pipeline into operation, after we got the line tested and purged through to Joliet, Illinois. The Chicago District Pipeline Company had constructed approximately 100 miles of 24 inch pipeline from Joliet into two points of delivery in Chicago. It was necessary to clean and purge this pipeline system. It was also necessary to fill certain holders with natural gas in this area. It was necessary to adjust certain appliances in the plants where this natural gas was going to be mixed with coke oven gas or manufactured gas, as the case may be.

We delivered gas to the Chicago District Pipeline Company for this purging and testing operation from August 19 to August 24, 1931. We delivered them some gas later, on September 24, 1931; at which time they completed their pressure tests. We then started making small deliveries to the Chicago District Pipeline Company for the purpose of tuning up our system and their system, on October 5, 1931.

In the meantime we experienced some difficulties. From

October 5 to October 15, 1931, we were making small deliveries of natural gas to Chicago District Pipeline Company. On October 10, 1931, we experienced a heavy rain in Bureau County, Illinois, in an area crossed by our main 24 inch pipeline. As a result of this rain, the back fill washed off the line. The pipe floated in the ditch, pulled out of the coupling, and we were faced with our first major failure of the pipeline transmission system.

We made the first delivery of gas under the contract of July 25, 1931, with Chicago District Pipeline Company on October 16, 1931. At that time our pipeline system was not completed. We had enough facilities completed that we could deliver gas, but we had many other things to do before the project was completed. For instance, at that time we had only eight wells delivering gas into the gathering system of Texoma Natural Gas Company. We were constructing lateral lines to the other wells to be connected, and finished this work on November 14, 1931.

We had a number of other things to do, such as installing repeaters on the telephone system, build pipe racks along the pipe line and store pipe, couplings and sleeves at these pipe racks for the purpose of making emergency repairs. We had to install highway markers where the pipeline crossed the various highways. We were erecting 484 anchor warning signs on the major rivers. We had a large amount of riprap work to do on the river banks and other points where we had made heavy excavations.

We were constructing drainage ditches and cross drains in order to take care of cross drainage, surface drainage, across the pipeline. We were also doing various work, such as finishing roads, walks, landscaping, water treating plants, and items of this kind around the compressor stations.

We were continuing with the work of getting the main compressor units into condition so that they would operate. As I have previously mentioned, this consisted largely of the replacement of the pistons and in the necessary operation of the unit in order to adjust the timing of the mixing valves to the various power cylinders.

We were building sales meters at Knoxville and Greenfield, Iowa. We started the construction of the Muscatine, Iowa, sales meter on October 31, 1931. We finished the sales meter at Wedron, Illinois, late in October, and we were building the Joliet sales meter at Joliet, Illinois.

We were delivering gas to Chicago District Pipeline Company before we had the Joliet sales meter constructed because we encountered delay in the construction of this meter setting due to difficulty in reaching an agreement with the Chicago District Pipeline Company as to the design of the meter station. Consequently we constructed a 16 inch by-pass line around the particular site that this meter station was to occupy, installed a 16 inch pair of metering flanges over this line, and metered the gas that was delivered to the Chicago District Pipeline through this by-pass line, while the main Joliet metering station was being constructed. We finished this meter station on December 10, 1931.

We were delivering gas through this line before we had it fully completed because we expected the Chicago load to come on slowly the first few months, and it facilitated the operations that we had to perform around the compressor stations if this system was operated and if it was delivering rather small quantities. Obviously, we could not adjust the engines without operating them, and the delivery of a small volume facilitated this work.

Also, the back fill over the entire pipeline system was new and fresh, and we were constantly patrolling this line and taking whatever corrective measures were necessary at various points to keep the back fill in place and to get the back fill settled as promptly as possible.

We were also continuing with our work on the river banks. Some of this work could be done up to a certain point and then it was necessary to wait until further settlement occurred before we could complete the riprapping.

485 The replacement of these pistons carried on until September 27, 1932. The adjustment of the main compressor units carried over until July, 1932. In other words, it was not until that date that we felt we had all of the compressor units properly adjusted so that they would carry their full rated load with any degree of satisfaction. As a date for the purpose of setting up the company books, we arbitrarily selected January 1, 1932, as the date to use for completion construction.

On October 16, 1931, when we made the first delivery of gas under our firm contract with the Chicago District Pipeline Company, the defendants had on their payrolls a total of 737 men. We had 127 men carried on the pay-

roll as operators and a part of the 127 were on stations, and, of course, some of their time was involved in this work of removing defective pistons and installing new pistons. The men carried as exclusively on construction work were 610.

During the period beginning October 16th and continuing for some time thereafter we were engaged in building up our operating organization. Some of the men who were to operate this pipeline system were selected from the personnel that had supervised the design and construction of the entire project. Of course, only the men who were qualified from an operating viewpoint were selected as operators, and those men who were not quallfied were later released. A part of the operators had been selected by this time.

On January 1, 1932, we had 273 operators and 212 men carried on the payroll for construction duties. There was work in the nature of construction work to be finished up after January 1, 1932. Some of the men who were carried on the payroll as operating personnel on that date were devoting their time in part to finishing up the construction of the pipeline. A large part of the time of the men who were carried on the operating payroll in connection with the compressor stations was utilized on construction duties, particularly in connection with these exhaust valve gaskets and the piston replacement work. The same thing was true to some extent with the pipeline operating personnel, but not to the same extent.

On January 1, 1932, when I became general superintendent of the two companies there was a change in the scope of my duties incident to the change of my title from chief engineer to general superintendent. Prior to this date my duties had been confined to the design and construction of this project, and I had also assisted in some of the preliminary selection of a few of the operators. However, when I was made general superintendent of the two companies, my duties expanded and became more executive and supervisory in nature, and included such items as selecting the remaining operating personnel, the organizing of this personnel into the various operating departments, and the supervision of these departments.

Later on, in 1932, I assumed some responsibility in connection with the administering of the affairs pertaining to

Texoma's acreage. Prior to January 1, 1932, Mr. J. G.
486 Dickinson, who was in charge of Texoma's acreage, had reported directly to Mr. Floyd C. Brown. Immediately after I became general superintendent Mr. Dickinson reported to me, and I gradually became involved in Texoma's acreage problems. This work had to do with the planning of Texoma's future drilling and development program, acreage trades, consolidation of leases, the expansion of the gathering system, and the expansion of the operating organization to handle the additional working and operating functions.

I also became involved in the development of facts pertaining to the Panhandle field as a whole, as a result of the heavy burden of litigation that Texoma has carried since it has been in operation in Texas. It was necessary to develop facts pertaining to Texoma's properties and the properties of other producers, facts pertaining to the Panhandle field as a whole, to the sour gas area, the sweet gas area, to geological conditions, and to see thatt hese facts were properly presented to the court.

I also assumed supervision of the company's sales organiaztion or sales department and supervised the market negotiations that this department carried on after January 1, 1932. It was the duty of this department to secure new contracts for the sale of domestic gas, new contracts for the sale of industrial gas, and to develop load building programs to increase the use of natural gas in the domestic markets that were then under contract.

As a matter of fact, as general superintendent I cover in the scope of my duties practically all of the executive ramifications of both of these companies, always, of course, under the direction of Mr. Brown, the general manager. I have been under Mr. Brown's supervision since 1919. I have been under his supervision on this one project since 1930 and have learned to know his policies fairly well. We confer in developing basic policies and I sometimes make decisions, all of which, of course, are subject to Mr. Brown's approval. Mr. Brown still says yes and no.

Questions by the Examiner.

As to what these sales programs were, when we secure a contract with a utility to distribute natural gas in a given town, we find that the consumption of that town is quite low, due to the type of market development that the

utility management has employed in the past when they were distributing manufactured gas. In order to develop the market to the extent feasible and possible with natural gas, it is necessary to carry out promotional campaigns in order to increrse the domestic consumption. This involves the use of more gas for commercial utilization, hotel cooking, restaurant cooking, summer hot water heating and more general automatic hot water heating, and also the use of natural gas to a greater extent in the heating of homes. It involves an appliance sales program in one phase of it, but that is not what it is directed at.

It is necessary for the utility to solicit this business. The business does not come to it. It obtains this business only through advertising and direct solicitation and by
487 the establishment of promotional rates that will entice the business, by the advertising of appliances that will accomplish the results, and by the necessary sales endeavor to bring about an increased consumption of natural gas.

For instance, usually when you take a town that has been using manufactured gas, the consumption per meter will run in the neighborhood of 15,000 cubic feet per year, but in a development program you can increase that consumption up to some higher figure, depending on the type of territory and the wealth in that town. Sometimes these consumers' meters get up to the point of 50,000 cubic feet per meter for domestic utilization, not including house heating.

Direct Examination by Mr. Morgan Resumed.

As to what was done with all of the drawings, specifications, bids, awards, contracts, etc., that were made up in connection with the construction of this pipeline, we have in the company files all of the construction contracts and specifications that go with those contracts. We have all of the drawings. We have all of the vouchers making the payments under those contracts. We have all of the purchase vouchers covering the materials. We have all of the drawings pertaining to the fabrication of those materials or articles. In fact, I think we have every paper that forms the basis of the development of this project and the expenditure of the money that brought it into existence.

We have kept similar drawings, specifications, bids, etc.,

for additions to the pipeline and for replacements and other things of that kind, where it was necessary to have those specifications, etc. All of the contracts, specifications or drawings that have been prepared since the original project was constructed are also in our files. Those files are available to the engineers of the Federal Power Commission and the Illinois Commerce Commission in case they desire to see them in connection with this litigation.

We have not kept the old preliminary reports that were worked out in a preliminary way as studies. We have had no need for the preliminary reports that led up to what designs we were going to use or what materials we were going to use. We have kept the design that we purchased or we have kept the drawing that was used in assembling the material. We have kept the purchase record of the material and we have kept the contracts that assembled the project.

When I went out to California to inspect pipe lines out there or went up to Milwaukee to inspect the pipe mills of Smith Brothers, or to Gary to inspect the pipe mills by which our seamless pipe was manufactured, as the records here show, I did not make a written report of all of those things to anyone. I made these investigations to inform myself and as a basis of my own judgment, and having made the investigations I discussed my conclusions with Mr. Floyd C. Brown, but I do not recall that I made any formal report on any of those investigations.

The results of all of those preliminary studies are reflected in the thing that was finally adopted and which
488 was evidenced in the drawings, specifications and other records which have been kept as permanent records of the company and which are now available to the engineers of the two commissions involved in this litigation.

I have mentioned litigation in which Texoma has been involved with the Texas Railroad Commission and the fact that it was necessary for me to make some intensive study concerning the physical facts obtaining in the Texas Panhandle. This litigation developed out of a determined effort on the part of certain interests to obtain, through legislation or orders of the Texas Railroad Commission, a market for all producers of natural gas in the Panhandle field. They were attempting to obtain this market from the various pipeline companies, including Texoma.

Texoma had fortified itself with the necessary gas reserves and as the result of the conservation policy that was being followed in the field Texoma's gas reserves were being drained. Texoma was unable to protect itself against this drainage because of its limited market outlet. For Texoma to purchase gas under these conditions would in effect increase the drainage from its properties, and, at least in some instances, would result in Texoma's purchasing its own gas from the wells of others.

As a result of this situation Texoma has been involved in five major lawsuits around this particular question. Because of the importance of these lawsuits, it became my duty to see that the full facts pertaining to Texoma's situation, the situation of other producers, the full facts pertaining to the Panhandle field as a whole, and the geological facts pertaining to the field, were developed and properly presented to the court at the time the litigation occurred.

Those studies made under my direction in connection with that litigation involved the estimation of reserves, the observation of pressure conditions, the ascertainment of facts concerning drainage, and the relationship of sour gas to sweet gas, of oil to the gas, etc., in that field. This work also resulted in my being informed in regard to the entire field to a greater extent than I might otherwise be if we had been concerned with Texoma's properties only, and it had the same effect on other members of the company's organization, particularly Messrs. Dickinson and Peterson.

(July 25, 1939)

It was not my thought at the time I took over my duties as general superintendent on Jannary 1, 1932, that the capital outlays of this pipeline project had all been made and completed. Due to our experience with other pipeline projects, we knew that projects of this kind required capital for various purposes during the years of its life.

In the case of this project, of course, we knew that Texoma was faced with a long acreage development program and that the drilling of additional wells would mean the building of additional lateral lines and meters. We knew that booster stations for these wells would be
489 needed in the later years of the field. We knew that capital would be required for other items, such as

water wells, cottages, future work on rivers, and items of this kind.

It became one of my early duties to confer with the operating heads, the chief engineer and other members of the organization, to minimize these capital expenditures as far as possible and to see that they were made in sufficient time to maintain the efficiency and capacity of the system and to protect the continuity of service. That has been a constant duty throughout the years that I have been general superintendent of these two companies. We have from time to time worked on various facilities in order to improve their efficiency or improve the capacity. We have diligently studied the Texoma acreage situation in order to minimize the amount of drilling required for the acreage and items of this kind. In spite of our constant endeavors in this direction, the two companies have experienced heavy capital expenditures each year of their existence.

I have the figures as to the amount of additional capital outlay expended or invested on the part of these pipelines beginning with the year 1932. The combined expenditures of the two companies, by years, have been:

1932	$ 558,435.46
1933	$ 325,321.67
1934	$ 309,872.53
1935	$1,327,080.20
1936	$1,131,145.58
1937	$ 709,818.95
1938	$1,041,394.86

This is a grand total of $5,403,069.25, or an average annual expenditure of $771,867.03.

Those are gross expenditures. I might say in this connection that these expenditures are in the years in which they were made and are not exactly coordinated with the years in which they were placed on the books of account. Subsequent adjustments might have been made back.

The number of men on the payroll of these two companies varies throughout the year. For the year 1938 it varied from 600 to 1,000 men. This variation is brought about by the different departments in the company, the different work that each of those departments performs, and the way the seasons affect different departments. I would say that 400 men are added for seasonal activities.

Questions by the Examiner.

The summer months, particularly July, August and September, are usually our biggest months. They are not necessarily always the biggest months, but usually they are. That is because in the other months of the year we are carrying such heavy loads on the pipeline and the compressor station equipment that we are able to carry out only a limited amount of maintenance then.

490 The number of operators, strictly operators, does not vary particularly over the year. When we come into the summer months, the operators being constant, the maintenance crews expand, because of the amount of maintenance work that we must perform on week ends, when the load is off, and matters of that kind, and then we also have various emergency jobs, or what may be termed emergency jobs, that we perform in the summer time. We will pick out the 4th of July to do some things that are done simply to guard service. We will pick out week ends or holidays, such as the 4th of July or Labor Day, to perform certain jobs that require shut-out of the line, and naturally those forces must be expanded considerably to handle that work promptly.

Direct Examination by Mr. Morgan Resumed.

The departments of the two companies may be described briefly by enumerating the Amarillo office of the Texoma Natural Gas Company, which is in charge of Mr. J. G. Dickinson. This office is generally referred to as the production department. However, in this office we have a number of divisions, such as the accounting division, which handles the books of account pertaining to the amount of gas produced, royalty to be paid, the production tax to be paid, and accounts of this kind.

Mr. Dickinson also has the land and lease division, which is headed by Mr. C. C. Kuhne. This department has to do with the keeping of the leases, observing the rental dates that occur in those leases, observing the obligations that accrue to Texoma under those leases, and has to do with acreage trades, acreage consolidations and matters of that kind.

Mr. Dickinson also has the division that is known as geological. This division contains Mr. C. J. Peterson,

chief geologist of Texoma, and Mr. W. F. Brainard, his assistant. They also have other personnel, such as draftsmen, stenographer, etc. This department is concerned with the location of Texoma's wells, field records, geological records, and development of geological facts in connection with Texoma's litigation.

Mr. Dickinson also has a production division, which is headed by Mr. Charles Galloup. It is the function of this division to supervise the drilling of a well, to see that it is properly cemented, properly cased, and properly completed, and this department also has supervision of the wells during their operating life. By that I mean that it is the duty of Mr. Galloup to ascertain when any work is needed on these wells and what should be done to keep the wells in the best producing condition.

Some of the divisions I have just given are field divisions. For example, Mr. Galloup's is a field division reporting into the Amarillo office. The divisions that have been described up to now are all under Mr. J. G. Dickinson's supervision in the general production department.

I am now coming to a description of the property originating in Texas and coming on north to Chicago, describing the departments that handle that property and the operation of the property. That is what I meant by field divisions. I did not mean the gas field. I have completed only the production phase of the gas field. I
491 have not mentioned the gathering system or the Fritch station or the booster stations or any of those features.

At Fritch, Texas, we have our first main line compressor station and gasoline plant. This station is under the supervision of Mr. R. T. Powers. Mr. Powers is superintendent of the Fritch compressor station and reports direct to Mr. G. M. Davidson, chief engineer and superintendent of operations in the Chicago office. Mr. Powers is supervisor of that entire plant, which consists of a compressor station and a gasoline plant, and in this gasoline plant is installed the equipment that performs the dehydration. In general the words "dehydration plant" and "refrigeration plant" refer to the same thing, except that I feel that the word "dehydration" is more accurate and descriptive, and the words "refrigeration" is more indicative of how the dehydration is accomplished. The way they have been used in this record those expressions mean the same.

Coming to the compressor stations of Natural Gas Pipe-

line Company of America, which number from 2 to 10, consecutively, these stations are under the supervision of Mr. W. H. Davidson, superintendent of compressor stations for the Natural Gas Pipeline Company. Mr. Davidson is located in the Chicago office.

Returning now to the Texas end of the system, we have the gathering system and we have the main 24 inch trunk extending from Fritch, Texas, to Joliet, Illinois. This is sometimes referred to in general as a transmission system, and this property is under the supervision of Mr. R. G. Strong, superintendent of pipeline operation for Texoma Natural Gas Company and Natural Gas Pipeline Company of America. Mr. Strong has general supervision of the present gathering system and booster stations and will have charge of the operation of the future facilities that are installed to expand the present gathering system and booster stations. His department has charge of all the field meters and all of the sales meters along the pipeline system.

The other division of the property is the telephone and pressure dispatching department. We have a privately owned telephone system, extending from Fritch, Texas, to Chicago. The system has various branches on it, connecting it to the Amarillo office, various points in the field, all of the compressor stations, and the regulating station and metering station at Joliet. This department is supervised by Mr. W. T. Bulla, who is located in the Chicago office.

In the Chicago office we have Mr. G. M. Davidson, chief engineer and superintendent of operations, to whom the various operating heads report, namely, Messrs. Powers, Strong, W. H. Davidson and Bulla. Mr. G. M. Davidson also has under his supervision the engineering department, made up of engineers, for preparing estimates for designs, for special problems, and he has under his supervision the drafting room.

The special problems division of the engineering department is headed by Mr. R. M. Bussard, and we supplant Mr. Bussard's efforts by supplying him with additional personnel from the company or with consultant from the outside when this is necessary. Mr. Bussard sometimes re-
492 ports to Mr. G. M. Davidson and sometimes he reports to me, depending upon who has given him the assignment with which he is confronted at that time.

The Chicago office also contains another department known as the accounting department. This is under the supervision of Mr. S. E. Campbell, the Secretary and treas-

urer of the two companies. Of course, this department has to do with the books of accounts and records of the company. To be exact as to Mr. Campbell's title, it is secretary and assistant treasurer of the two companies. He has charge of the records of the company.

All of those department heads have various subdivisions working under their directions. They all have assistants. Sometimes they have assistants in the Chicago office and sometimes their assistants are located in the field.

For example, Mr. Strong has division heads under him. The division heads are located on the property in the field. He has one division superintendent located at Fritch, Texas, Mr. L. D. Williams, and Mr. Williams has the immediate supervision of all of the gathering systems, the meters, and the main 24 inch trunk pipelines north to Station 2, and also of the present booster station. Mr. Strong has other superintendents up the line. He has three in total, two others in addition to Mr. L. D. Williams. He has Mr. Hugh Smith, located at Great Bend, Kansas. Mr. Smith has the immediate supervision of the 24 inch pipeline system extending from Station 2 to the Missouri River. He has Mr. E. D. Warren, located at Station 9, which is near Harper, Iowa, and Mr. Warren has immediate supervision of the 24 inch trunk pipeline system extending from the Missouri River to Joliet.

Mr. W. H. Davidson, who supervises the operation of the compressor stations of the Natural Gas Pipeline Company system, has a superintendent in charge of each of the nine stations under his supervision. This same general type of organization is carried out in each of the other departments.

Mr. Powers has supervision of his department. Mr. Hammerschmidt, who has testified here, is in charge of our Fritch laboratory, which is part of the Fritch station, and Mr. Hammerschmidt reports direct to Mr. Powers unless he is withdrawn from his regular assignments to investigate some special matter.

I have mentioned our special problems department, headed by Mr. Bussard. We assign to this department problems pertaining to the company business, but not immediately connected with the operation functions that are being performed from day to day. These are problems that we wish to have solved in order to guide us in some future capital expenditures or to guide us in some operating policy. The engineers in the engineering department are usually interrupted so frequently with requests from the vari-

ous operating heads that we find that we can make better progress with the solving of special problems by assigning to them a group of men that are not interrupted. Mr. Bussard's efforts are supplemented by any additional per-
493 sonnel that may be needed, and if we are unable to obtain this personnel from the system we obtain consulting engineers from the outside.

We also have a new business department. This new business department came under my supervision as of January 1, 1932, and it has been the function of this department to secure additional contracts for the sale of domestic gas, additional contracts for the sale of industrial gas, and to develop the market outlet under these two different kinds of contracts. This department is in charge of Mr. H. O. Loebell. Mr. Loebell is a man that has had many years of experience in the development of markets for natural gas, particularly in his association with the Cities Service Company, and he is also a national authority on the combustion of natural gas. This department has varied from twelve to two men, depending on the amount of negotiation work being carried on. We have two men in that department now, one of them on part time.

As of January 1, 1932, when I became general superintendent, our daily deliveries of gas were fluctuating between sixty-five million and eighty million cubic feet. Part of the delivery was temporary. The firm portion of the delivery was approximately fifty-five million cubic feet. As of that time, that left an unused capacity of 95 million. The total capacity of the line as it was originally constructed was 175 million cubic feet per day.

Down to that time Natural Gas Pipeline Company had the July 25, 1931, contract with Chicago District pipeline Company and we had contracts for the sale of gas to four small towns located adjacent to our pipeline. Those contracts were not closed transactions so far as the activities of the pipeline were concerned. All that had been accomplished was the securing of the contract and in most cases natural gas service had been established, but there had been no market development take place either in the domestic phase of the business or in the industrial phase of the business.

From the standpoint of Natural Gas Pipeline Company in connection with these contracts it was necessary, in order to utilize or realize the full potentialities of the market, to encourage and assist the utility management in charge of

the various properties in the development of their market territory. These endeavors took the form of guiding them into sale of natural gas for house heating and into the sale of natural gas for industrial utilization at special rates.

Our new business department had to do with these further promotional activities under existing contracts, and it also had to do with going out and getting new contracts. The promotional activities that we carried on under the contracts then secured were only a part of the function of this department. We went forward in a very aggressive manner, endeavoring to secure additional contracts for domestic utilization and industrial utilization with other utility operators that were operating gas properties in towns adjacent to our pipeline. This was one of this department's very major functions.

Although the pipeline system is now loaded approxi-
494 mately to its full capacity, it is still necessary to maintain this new business department. It is not only necessary to load a pipeline, but in the case of this line a part of this load was secured under temporary contracts, and it is necessary to conduct negotiations for the purpose of renewing the contracts from time to time—in other words, to maintain the full load condition. We also find that it is necessary to have a department of this type for the purpose of rendering what might be called service. Some of the utility operators, having had no previous experience with natural gas, are confused at times as to what is the best policy to pursue, and due to the occasional industrial changes that take place in their property, they need guidance as to what they should do to keep their own service on a proper basis and keep their property earning its maximum. Consequently, in recent years, outside of the negotiations for renewal of the expiring contracts, we have used this department largely for servicing the contracts already secured.

The line has been substantially loaded since the beginning of 1936. The market negotiations directed at the loading of the line were carried out under my supervision and extended from January 1, 1932, until the beginning of 1936. Since that time there have been negotiations resulting in additional contracts and in the renewal of additional contracts, but the majority of the loading of the line, or the negotiations that resulted in loading the line, occurred from 1932 to 1935, with the exception of the negotiations that pre-

ceded the former date that resulted in the five contracts I have previously mentioned.

The building of this load involved cost to the pipeline company in addition to the salaries and office expenses of those engaged as operators in the new business department. I have already referred to the amount of volume that we were handling as of January 1, 1932, and in spite of strenuous efforts on our part the sales volume realized in 1933 was less than it was in 1932. The depression was getting progressively worse and we were faced with a very critical situation. Consequently, it was necessary for us to take many steps in order to overcome the difficulties and handicaps facing us. In other words, to expedite the attachment of these markets at a more rapid rate and in order to encourage the development of the markets, we made cash contributions to the new business activities on the part of these utility operators that had signed contracts with us. This expenditure totaled in the neighborhood of $1,500,000. These expenditures were cash contributions to the utility companies and equaled a million and a half dollars.

We also made contributions to those load building campaigns by furnishing natural gas under special contracts for limited periods of time at concession prices. These contracts of this type enabled the utility companies, through concessions in price on the industrial gas, to amortize the aditional capital that was required to make the natural gas available to the industrial consumer and to amortize the capital required for the yard piping, the burners, and the furnace changes in the plants of the various industrial consumers.

Cross-Examination Interposed by Mr. Slaff.

It is not completely correct to say that those concession prices allowed the consumer to amortize the additional
495 cost involved to him. You can start at either end.

There are two prices in the chain, our price and the price of the utility to the customer. By making a concession price on our part, the utility management was able to make a concession price to the consumer, so in those two divisions is the amortization of the capital expenditures on the part of the consumer and the capital expenditures on the part of the utility that made the natural gas available to the plant. When I refer to the utility management or the utility amortizing the capital, I am referring to the

utilities that signed contracts with Natural Gas Pipeline Company of America for the purchase of natural gas to be resold for domestic consumption and that signed contracts for the purchase of natural gas to be resold for industrial consumption; in other words, our purchasers.

Direct Examination Resumed by Mr. Morgan.

The original capacity provided for in our system was 175 million cubic feet a day. That capacity was increased during the period from the beginning of 1932 to the end of 1935. We increased the capacity of the system in various steps. We did this by making certain changes in the compressor station equipment and by raising the intake pressure and the discharge pressure imposed upon the compressor stations. We also installed additional equipment in some of the compressor stations in order to realize this increased capacity. I do not have the dates at hand as to just when those steps were taken, but they were taken prior to 1936. It was during the interval from the time I began functioning as general superintendent on January 1, 1932, and the end of 1935.

Questions by the Examiner.

None of those concession contracts is still in effect. I have not refreshed my mind recently on the exact form that the contractual relationship took that covered the payment of these cash contributions, but I can describe them in general.

We would approach the utility management operating the gas distribution property in a given town and by discussion and negotiations with the management develop that that particular town should have a market development pertaining to house heating up to a certain point, or, at least, to a certain degree. We would then attempt to determine the cost of the campaign that would bring about the utilization of natural gas in this town to the extent that we had discussed. In the total cost of the campaign would be included such items as newspaper advertising, direct mail advertising, direct solicitation, advertising of appliances, and the establishment of sales policies pertaining to the sale of equipment on time payments, and many other costs.

Direct Examination Resumed by Mr. Morgan.

That would include the demonstration of gas burning appliances in the homes and in other places where they hoped to sell gas, if those features were incorporated in the sales campaign. The campaigns were not always the same for different towns. The campaigns were designed to fit the particular town in which the campaign was to be conducted, and in some cases it was necessary to set up demonstrating units in some public place where the utilization of natural gas could be demonstrated in a modern cooking range or in an automatic water heater or in an automatic gas fired furnace.

Having reached a general agreement as to the extent
496 of the campaign and the objectives to be realized and the cost of the campaign, we would then decide on what portion of this total cost we would bear. We made these payments to the utilities in cash in various manners. One common form that the payments took was this: We said that for each additional house heating customer that you secure we will pay you X dollars. Also, we will consider as an equivalent of a house heating customer the sale of so many space heating circulating heaters, or the sale of so many radiant heaters. The attachment of any additional business, be it house heating through central heating plants or heating through auxiliary equipment, was converted into the equivalent units of house heating central heating plants. We then made our payment to the utility based upon the number of additional customers secured and the extent to which they carried out the campaign. That was one very common form of cash contribution.

Cross-Examination Interposed by Mr. Slaff.

These new business expenses I have spoken of were entered in our books of account; but I am not sure of the classification. I am not an accountant.

Direct Examination Resumed by Mr. Morgan.

I referred to increasing the capacity of the line by some changes in the compressor stations. We installed additional power or compressing units in the Fritch station, also in Stations 2, 3 and 9. We installed unloaders on the

compressor end of those compressing units in all of the stations of Natural Gas Pipeline Company's system and on a part of the units of the Fritch station of Texoma Natural Gas Company.

An unloader in the sense I am using the term in connection with this property is an addition to the compressor end of the main compressing unit that may be used to vary the amount of clearance in the compressor cylinder. This permits the operation of the compressor unit over a wider and different range of pressures than you could have operated it without overloading the main power end of the unit without the unloader.

We also raised the intake and discharge pressures at the compressor stations, and I am not certain, but I think we enlarged the dehydrating equipment in the gasoline plant. There may have been a few other minor changes I do not think of at the moment.

I have been asked why we designed and constructed our pipeline with a capacity to handle 175 million cubic feet of gas daily from the beginning, when we had a firm market for only about 55 million a day and a spasmodic or temporary market for some twenty or twenty-five million in excess of that, instead of building it with a capacity to handle the gas that we had sales for at the time we built it. The volumes of sales I refer to as existing January 1, 1932, namely, 55 million firm and 80 million in total, including the interruptible, were the volumes that the market then required prior to the market development and prior to the connection of additional towns. We, through investigation, had determined that the natural gas requirements of these markets would be at least 175 million, if not more. Therefore, we attempted to select the most economical size of line that could be constructed at that time to perform the service that was expected and that would provide adequate gas for this area. To have constructed a smaller line, one more in keeping with the size of the load that
497 would come on originally, and later construct a second line and a third line, and so on and so forth, would have resulted in a cost far in excess of that which we had with the single line and the venture would not have been feasible.

It certainly would have been a handicap to our building up our load if we had to go out and sell gas and then build the pipeline to start delivering it. It has been our experience that you have difficulty in negotiating contracts

for the sale of gas unless you can show that you have the gas to sell and show that you have the financial ability to make it available. Having constructed this line and having the gas in the field and having a system that was operating, we were in position to talk about the sale of something that we were ready to deliver immediately.

We thought the economies to be accomplished by building this capacity in advance and the advantages of our having the capacity at all times available as we built the load would more than offset the interest and the maintenance and the operation and depreciation on the unused portion of our line during that period of load building. We did not expect, however, that it would require the length of time to load this line that it did require. We were wrong on the depression.

Negotiation of all of these contracts consumed considerable time, some contracts more than others. I would say that negotiations sometimes extended over a period of months and sometimes over a period of two or three years. The difficulty we encountered was that it was necessary for us to convince the management of these utilities that the introduction of natural gas into their property and the changing of their service from manufactured gas to mixed gas or straight natural gas would prove to be feasible from their viewpoint.

It cost money to change over from artificial gas to natural gas. The utilities in introducing natural gas have what is called the change-over expense. This involves the expense of adjusting all their customers' appliances to consume the natural gas rather than the gas that had been distributed formerly. They also had certain capital expenditures. In some cases the utility laid lateral lines to the city in order to take the straight natural gas from the point of delivery on our system into their distribution plant. Sometimes it had capital expenses for the installation of equipment in order to odorize the natural gas before it was distributed. Sometimes they had expenses to their equipment if they were going to distribute mixed gas, a blend of natural and manufactured or a blend of natural and coke oven gas. The utilities had various expenses of that kind and they also had the problem of working out the new rates with their regulatory bodies. Usually these negotiations resulted in the rates to the consumer being reduced, with the result that the operating economy of the utility operator was affected.

Cross-Examination Interposed by Mr. Slaff.

I can give you a list subsequently of those instances in which rates to the consumers were reduced.

498 *Direct Examination Resumed by Mr. Morgan.*

We met with other sales resistance in addition to that coming from the natural aversion on the part of those with whom we were negotiating to spend additional money and to go to all of the expense and trouble incident to making the changeover. There were other elements of resistance encountered in our efforts to develop these markets. Even after we had the utility management convinced that the venture was feasible, and even after an agreement had been reached in regard to the rates at which the natural gas would be resold to the consumer, we still had opposition. This opposition came from a different source, usually from those interests that were financially affected by the introduction of natural gas, namely, the railroads, the coal producers, coal dealers, and some labor unions. These factions sometimes took an aggressive position early in negotiations and sometimes later. They occasionally appeared before regulatory bodies trying to prevent the introduction of natural gas. Other times they would carry on publicity campaigns designed to create uneasiness in the minds of the public.

By alleging that natural gas contained dangerous sulphur compounds and was injurious to the health of the consumer, and by alleging that natural gas would darken the pots and pans and the silverware of the housewife, they attempted to emphasize that the utilization of natural gas in the home was extremely dangerous, and whenever they could locate some instance where a catastrophe had occurred in connection with natural gas they gave this incident wide publicity.

They also attempted to play upon the local sympathies of the public by pointing out to the delivery trucks and the local coal dealers how it would affect their business. These efforts on the part of the various interests were not always the same in every locality. Sometimes in some places they were more aggressive than others. Railroads even went to the extent of establishing special freight rates on coal to towns where it was proposed natural gas be introduced.

In the case of the industrial consumers, these consumers were concerned with the cost of the yard piping, cost of

burners, cost of furnace changes, if any were necessary, and they were also concerned with the utilization of natural gas and how the use of this fuel in their plant would affect their product. The industrial consumer was not interested in taking these chances unless he could see that his additional capital for the lateral line and burners could be amortized and he could also realize some saving to himself in his fuel cost.

The element of interrupted service was one of the difficulties we had to deal with in our effort to dispose of industrial gas. The coal interests, in an endeavor to hold the industrial consumers of coal, would point out to the prospective industrial customer that this gas was coming from the State of Texas, that its service might not be reliable, and that a shortage of fuel might be extremely expensive, and this hazard was particularly emphasized in the case of the glass customers. The nature of this particular process is such that a sudden interruption of a fuel supply would result in loss of a considerable amount of product and might even spoil some of the furnaces.

499 In negotiating these contracts for the sale of gas to be used as industrial fuel, we were not able to assure the purchaser, and our purchaser was unable to assure his purchaser, that he could get this gas continuously from day to day, from the first of the year to the last of the year. We did not attempt to sell the industrial gas on that basis. The contracts covering the sale of natural gas for domestic utilization gave the purchasers of gas under these contracts prior rights to a supply of gas, and our obligations in regard to the class of service to be rendered under the domestic contracts were different than the obligations that we assumed under the industrial contracts. It was necessary to give these domestic demands prior call on our capacity; otherwise they would not be interested in the contract at all.

Gas used for domestic purposes is subject to a fluctuating demand in different seasons of the year. We were able, with a capacity of 175 million, to protect the domestic users who relied upon our system as the source of their gas so that they would at all times have their full needs for domestic requirements, whether it be cold or hot or whether they wanted to cook a big meal or a little one. I explain that in this way:

The carrying of the two classes of service on a pipeline facilitates the rendering of the preferred class of service.

By that I mean having contracts for supplying natural gas to domestic markets and also having contracts for supplying natural gas for industrial markets enables us to render a more reliable and a more certain service to the domestic market. This is true because of the increased volume of gas being transported through the system, because of the increased amount of gas packed in the pipeline system, and because the consumption to the industrial consumer can be interrupted to meet the peak requirements of the domestic utilization.

Therefore, regardless of the weather and the calls upon our system for gas for such purposes as cooking and house heating and other domestic usage, we are always able to supply those requirements because they are well below the total capacity of our line, except, of course, when we may be confronted with some catastrophe such as a complete disabling of service.

If the domestic load during the winter months or some season of blizzard reaches a point where we are not able to sell the quantity of gas that we have been selling previously to our industrial customers, the operation of the various classes of contracts is such that the first delivery is to the domestic contract and the domestic consumer. Consequently, the entire requirements for this market are met, and then if there is any additional gas remaining it is sold to the class of industrial consumers that have purchased preferred service in the industrial classification. In other words, when we have not the gas available after supplying our domestic demand, some industry has to be cut off until that domestic demand goes down to where we have the gas available. That happens frequently.

500 *Questions by the Examiner.*

Natural Gas Pipeline Company of America has approximately seven direct contracts with industrial consumers. I am not certain of the exact number. When I referred to industrial contracts, in my previous testimony, I was not confining the term to the industrial contracts that we hold directly with the industrial consumers. I was also including all the contracts that we have with the utilities to cover the supply of natural gas to be resold for industrial consumption. Our obligation to deliver gas under our industrial contracts with the utilities is contingent upon the utilities following a certain schedule in their delivery of nat-

ural gas to their industrial customers. That is not a part of the agreement of July 25, 1931.

By requiring the utilities to curtail delivery in a certain order in our industrial contracts with the utilities, we automatically assure that the service to the domestic market will not be interrupted. The utilities, in turn, take certain steps in their contracts with the industrial consumers to enable them to carry out the proper program, but the clauses in these contracts between the utility and the industrial consumer are not uniform in language or in principle. We do not require that the utility submit to us for approval each industrial contract.

Direct Examination by Mr. Morgan Resumed.

Natural Gas Pipeline Company has negotiated 161 contracts for the sale of gas. Five of these contracts had been negotiated and signed by January 1, 1932, at the time I took over the supervision of the new business department. However, I have been concerned with these contracts since they were executed, particularly with those phases that pertain to market development under these contracts. With all of the other contracts included in the 161, I have supervised the negotiations that led up to the execution of the contracts. I have participated in the negotiations in a great many instances.

Of these 161 contracts, 47 are still in effect. Of those 47 contracts, 20 cover a supply of natural gas to be resold for domestic utilization. These 20 contracts are ordinarily referred to as firm contracts. Our obligation to deliver under each of those 20 contracts is a firm obligation as opposed to interruptible.

These 20 contracts continue in effect for a definite time, but not all for the same length of time. One of these contracts expires in 1939, eight in 1941, and eleven in 1946. Included in the eleven is the July 25, 1931, contract with the Chicago District Pipeline Company, which may be extended for a period of five years beyond 1946 at our option.

That leaves 27 of the 47 contracts for other than domestic purposes. Two of the 27 are Texoma contracts, covering the sale of natural gas at the mouth of the well to other pipeline interests. Some of the remaining 25 contracts are contracts between Natural Gas Pipeline Company and industrial consumers direct. There are approximately seven

of those. I am not certain as to the exact number. The
501 remaining contracts in that group are industrial contracts with utility companies covering a supply of natural gas to be resold for industrial utilization.

The two contracts of Texoma to which I referred are with other pipeline interests, and are in addition to its contract with Natural Gas Pipeline Company of America. Texoma has two contracts covering the sale of natural gas at the mouth of the well to other pipeline interests. One covers the sale of natural gas from Texoma wells located in Wheeler County, and this contract is with the Lone Star Gas Company. The contract is subject to cancellation by either party on sixty or ninety days notice—I am not certain which. The other contract is for the sale of natural gas from certain Texoma wells located in Gray County and is with the Coltexo Corporation, I believe there are five wells involved in the Lone Star contract and eight wells involved in the Coltexo contract.

As to why we sell gas when we need it ourselves, some of these wells are located in Wheeler County and some in Gray County, and when we constructed the gathering system we deferred extending it sufficiently to permit those wells to produce into our own pipeline system. Furthermore, the wells in Wheeler County were then connected to the Lone Star Gas Company and we were receiving revenue from the sale of the gas. All of those wells were already on the original blocks of acreage that we acquired.

These wells are so remotely situated with reference to our pipeline system that we cannot deliver the gas from them into the pipe line and we do not deem it economic to build to them in the light of the fact that we have more gas than we can sell to the west of there. We had the choice between selling gas from the wells to those interests that were willing to buy it or to make the necessary capital expenditures to connect the wells into our own system. Due to the development situation on the acerage adjacent to the system constructed, we have not needed the gas from these wells and have continued to sell it. If it is not sold, it will be drained away from Texoma's properties, and we are selling it and putting the revenue into our general revenue.

(Request by counsel to the two commissions for data underlying the economic problem outlined in the foregoing paragraph objected to by counsel for the company. The Examiner took the request under advisement.)

As a matter of fact, under the conditions in that field, Texoma would not be able to produce any more gas into its system during the life of the field if it had those Coltexo and Lone Star wells connected to its pipeline system. The record already shows that tremendous quantities of gas have been drained away from Texoma's properties, and if we were taking a part of our load from those wells in Wheeler and eastern Gray County that drainage would have been increased somewhere else to offset it.

The 25 industrial contracts, whether they be directly with the industrial consumer or with purchasers who in turn resell to the industrial consumers, are not permanent contracts. They are relatively short in length. Fifteen expire in 1939. Three expire in 1940; four in 1941; one in 1942; and one in 1946, and one contract runs until cancelled by either party on thirty days' notice.

502 It is my experience that when it is necessary to renew these contracts a certain amount of negotiation is required. The amount is not always the same in each instance, but the utility with which these negotiations might be conducted often has changes that it desires to make in the contract, and sometimes the negotiations pertaining to these changes consume considerable time.

These contracts do not all provide for the same price. The price in these industrial contracts is the result of negotiations, and the difference in price is accounted for by the difference in the service to be rendered by us in delivering gas under the contracts. We naturally negotiate for the highest price we can obtain on these contracts. The difference in price is due to the class of service that will be rendered under the different price classes. I mean that the higher priced industrial contract enjoys a class of service superior to a lower priced industrial contract. I am speaking of the industrial contracts between ourselves and the utility which resells the gas to the industrial consumer. The utility in reselling the gas to the industrial consumer makes price classifications based upon the class of service rendered also.

By the class of service I mean that the lowest priced industrial contract is the service that is interrupted first when there is a shortage of natural gas. Following that the next lowest priced service is interrupted if there is still a deficiency of supply of natural gas. In other words, if we have a heavy call on our capacity for domestic gas due to cold weather or some other consideration, and it is

necessary to cut off temporarily a part of our industrial load, we cut off the fuel on the one that is paying the least for it first.

That happens because the total amount of gas available, of course, limits the amount that can be resold, and the operation of the contracts between Natural Gas Pipeline Company and the various utilities is such that it requires the utility to curtail or discontinue service to those customers in the lower priced utilization. These customers are sometimes grouped into general classifications, namely, boiler fuel customers, steel customers, glass customers. The general scheme of the operation of the contracts is that the customers paying the highest price for the industrial gas are interrupted last, and, in turn, our obligation to deliver the gas for the highest priced industrial consumer follows immediately after our obligation to deliver the domestic gas and before we deliver any gas for any lower priced industrial contract.

In conducting these negotiations we find that the man who is to be interrupted last and who may have a good chance at continuous service is willing to pay more money in order to be placed in that position.

As a practical matter, that limitation which we place upon our purchaser in our contract for the sale of industrial gas imposes the same limitation upon our purchaser when he resells it to other customers. I have already stated that our industrial contracts with the utility companies require that the utilities carry out this scheme of curtailment to the lower priced industrial customer before they curtail deliveries to any higher priced industrial customer.

This is done by stating that our obligation to deliver
503 any quantity of industrial gas is contingent upon their following the said schedule.

Questions by the Examiner.

We do not have a similar provision in our July 25, 1931, contract, with Chicago District Pipeline Company. That contract covered a supply of gas that was to be a firm supply, with the exception that it did cover for a short period an additional supply of natural gas which was not firm and which was to be resold for certain specific uses. In that case we had only one contract involving two classes of service and only one price involved in the interruptible

class of service. Later we negotiated industrial contracts with the Chicago District. By that I mean contracts covering a supply of natural gas to be resold for industrial utilization. These contracts came into existence in a certain order.

In the first contract there was a supply of natural gas to be resold as boiler fuel. Later there was another contract for a supply of natural gas to be resold to steel companies. There was also a contract covering a supply of natural gas to be resold to glass companies. In these three industrial contracts, with different prices, different service requirements were imposed upon the utility.

In order that the service to the highest priced industrial class of customer be satisfactory, and in order that those customers be retained, it was essential that the service to those customers be not disturbed at the time when service was being rendered to industrial customers paying a lower price. Consequently, the arrangement and provisions of the industrial contracts that operated separate from the July 25, 1931, contract was such as to require the utility to make delivery to the highest priced industrial customer and then to the next priced industrial customer, and that in the event of a deficiency in the total amount of natural gas available, the lowest priced industrial customer would be interrupted prior to any other priced class of customer.

Direct Examination by Mr. Morgan Resumed.

The industrial customer is not bound to consume any quantity of natural gas. In effect, these contracts are options on his part as to the amount of natural gas that he takes delivery on and consumes. The contract serves the purpose only of stating the price that is to be applied for the amount that he does take and consume, if he takes it.

In addition, in some cases there was included in the contracts between the utility and the industrial consumer certain minimum monthly charges for the purpose of amortizing the capital in the industrial meter that the utility provided for metering the gas to the consumer, but, in general, the contract between the utility and the industrial consumer is in effect an option on the part of the consumer, and he can take the gas and consume it or he can leave it. Our purchaser has that same option with reference to the gas going to that kind of a customer.

This element of uncertainty operates to vary the de-
504 mand for industrial gas from time to time. It is not only the element of uncertainty, but the particular business conditions affecting the industry and the particular policy that that industry is following in regard to the number of days per week that it operates, and items of this kind affect the demand for industrial gas. If the industry is shut down or curtailed as a result of adverse business situations, the deliveries under the industrial contracts go down the same as the consumption of the customers goes down. This is brought about not only by business conditions, but is affected to some extent by weather conditions.

This runs into substantial money. For instance, between the year of 1937 and the year of 1938, the volumes of natural gas delivered for industrial consumption declined from 29,118,904,000 cubic feet in 1937 to 24,304,875,000 cubic feet in 1938. The revenues declined from $3,775,215.64 in 1937 to $3,069,485.53, a difference of approximately $706,000.00.

Cross-Examination by Mr. Booth Interposed.

We have participated in negotiations between the utility and the prospective industrial consumer in many instances. When I use the term "utility" I am referring to all the utilities that purchase gas from us.

In recent years I do not recall that any prospective industrial customer has applied directly to us for service except customers located immediately adjacent to our line or customers located outside of corporate limits. In the early days, back in 1932 and during that period, there were instances where the industrial customer applied to us for service.

Direct Examination by Mr. Morgan Resumed.

As a matter of fact, the pressure is generally from us to the utility and from the utility to the prospective customer in order to acquire and attach this business.

Questions by the Examiner.

We do not sign the contracts between the utility and the industrial consumers in any way as guarantor of the agreement. Our industrial contracts with the utilities require that those contracts be sumitted to us; but we are not a

party in any way to that agreement so far as signatures are concerned.

Direct Examination by Mr. Morgan Resumed.

I have been asked as to the protection of the firm load against the operation of the industrial contracts. The July 25, 1931, contract between Natural Gas Pipeline Company of America and Chicago District Pipeline Company provides for a firm supply of natural gas, and Natural Gas Pipeline Company is entitled under that contract in all events except in the case of force majeure. The pipe-
505 line company has no option about delivering the quantity required under that contract. The pipeline company delivers additional quantities of natural gas to Chicago District Pipeline Company under other contracts which are termed industrial contracts in general and which provide for an interruptible supply and these contracts contain a provision that in effect protect the quantity of natural gas required to be delivered under the July 25, 1931, contract.

The Chicago District Pipeline Company is required to submit copies of the contract that they or the local utility executes with the industrial consumer, after the contract is executed—that is, the contract between the Chicago District or the local utilities and the industrial consumer. They are submitted to us after they are executed. It is not required that we approve those contracts. It is required that they file them with us after they are executed in order that we be informed about the situation and to facilitate our preparation of the gas bill at the end of the month.

I recall only one instance where we sat in the negotiations between our purchaser and the prospective industrial consumer. In that instance we were present in order to stimulate the interest of the prospective customer in the use of natural gas and to determine whether or not we could be helpful in explaining to the prospective customer how he could use natural gas in the proposed utilization.

As stated, the pipeline was loaded from early in 1936. The volumes of natural gas sold by Natural Gas Pipeline Company of America under all of its domestic sales contracts for each of the years have been as follows: 1936, 44,568,561,000 cubic feet; 1937, 45,357,989,000 cubic feet; 1938, 44,454,164,000 cubic feet. The average of these three years is 44,793,571,000 cubic feet.

The volumes of gas sold by the company during the same period under its interruptible industrial contracts have been as follows: 1936, 25,046,776,000 cubic feet; 1937, 29,118,904,000 cubic feet; 1938, 24,304,875,000 cubic feet. The average for the three year period is 26,156,852,000 cubic feet.

The combined volumes for domestic and industrial sales for each of the three years have been: 1936, 69,615,337,000 cubic feet; 1937, 74,476,893,000 cubic feet; 1938, 68,759,039,000 cubic feet. The average for the three year period is 70,950,423,000 cubic feet.

Based on my experience through the entire operating life of this pipeline company in negotiating the various contracts under which Natural Gas Pipeline Company has sold and delivered gas, and my knowledge of the conditions under which we are now marketing and will market natural gas in the future, I have an opinion as to the volume of gas we will probably be able to sell and deliver over the next ten or fifteen years.

Assuming that the natural gas is available and can be economically produced, which will not be for a period of fifteen years, my judgment is that the average annual volume that Natural Gas Pipeline Company can expect to sell year after year in those years when the gas is available
506 is an average of the three year period, 1936 to 1938 inclusive. This average volume is 70,950,423,000 cubic feet.

During the period of 1936 to 1938 inclusive, the system and equipment have been in an efficient operating condition. We have operated this system at capacity, in fact on many days in each of those years the main compressor units have been operated at loads in excess of their normal rating.

In arriving at this average sales volume for the future, which I expect to be the maximum average sales volume per year that this company can expect to realize, I have not only considered the condition of the equipment and the way it has been operated, but I have also considered the load conditions that we have experienced, the seasonal influences on these loads at various points, and I consider the average of the past three year period a good measure of the sales volumes of this system for the future.

We may have occasional years when we will exceed this average sales volume, but we will also have years in which we will not realize the average sales volume, as we did in 1936 and 1938.

I have said that we will not be able to sell and deliver these volumes over the next fifteen years because we would not have the gas available. As to the period over which I think we will have gas which can be economically produced and made available for sale in such volume, I will say that, assuming that we continue to make the capital expenditures necessary to carry out an adequate development program on Texoma's acreage and that the necessary capital is provided for the lateral lines, meter stations and booster stations that will be needed later in order to produce these wells into Texoma's system, and assuming also that proper operating and maintenance expenses are incurred to keep the system in efficient operating condition, and that Texoma does not lose any gas wells connected to its system, I think we might be able to produce the necessary volumes from Texoma's property to market the volume stated from the system of Natural Gas Pipeline Company until the end of 1951 or early in 1952.

However, by this time the rock pressure of Texoma's wells are going to have declined and will range between 75 pounds and 135 pounds, depending upon the particular part of the field in which they are located. Also, in my judgment, Texoma will have lost a large number of wells due to salt water, due to changes in the producing formation, and due to mechanical defects.

Already in the Panhandle field there have been some 80 or 90 wells abandoned at pressures in excess of 100 pounds. Texoma itself has plugged eight wells. I know that Texoma is going to lose at least six additional wells in the next two or three years. We are also currently finding it necessary to blow Texoma wells in order to free the well bore of cavings, and water, and in order to clean the producing formation.

We are able to keep the present Texoma wells in an
507 efficient producing condition now by this blowing operation, except in occasional instances where it has been necessary to move in clean-out tools and carry on rather extensive clean-out operations in order to restore the well to proper producing conditions. This method of conditioning wells is particularly effective now because of the pressures that exist in the formation, being pressures sufficient to flush the formation and to prevent it from clogging. However, in later years, after the pressure has declined, the method of blowing wells for the purpose of cleaning

the producing formation will not be as effective as it is at higher pressures.

I feel certain that Texoma will lose a considerable number of wells due to the clogging of the formation, due to mechanical changes in the casing, and due to changes in the formation; and, in my opinion, the lowest safe pressure condition that Texoma can expect to have all of its wells perform at is in the neighborhood of 100 pounds.

I am not able to predict the number of wells that Texoma is going to lose, nor am I able to predict the time that it will lose them. I am certain that declining reservoir pressures and other changes in the field will aggravate the problem of keeping these wells in good producing condition.

I have in mind also that in the later years Texoma will be producing its wells at a higher per cent of their open flow than the average condition that now exists on Texoma's wells. In general, we are now operating at from eight to ten per cent of the open flow of the wells. We have, however, in times past operated some of our wells in excess of twenty per cent of the open flow of the well, and we have found that this operating condition increases the operating difficulties of keeping the well in proper producing condition, because it accelerates the clogging of the formation and it seems to accelerate the intrusion of water into the well bore.

By 1951 the majority of Texoma's wells will be producing at 25% of the open flow of the wells, or some time prior to that time, depending upon the number of wells that Texoma loses, and depending upon the amount of drilling that is carried on, and matters of this kind. I am convinced that, as a practical matter, the situation associated with Texoma's wells will bring about a shortage of open flow two or three years prior to 1951 to the extent that Texoma will not be able to furnish the necessary volumes to enable the pipeline company to realize the sales volumes, the average sales volumes, that I have predicted; and that contemplates the development of Texoma's leaseholds to the maximum extent that we believe is economically advisable.

When the time comes that we cannot deliver the full volume of gas which I have stated, namely, the average volume which the pipeline has sold and delivered during the years 1936 to 1938 inclusive, whether that be in 1951, 1950, 1949 or 1948, we will then discontinue the delivery of natural gas under the interruptible industrial contracts that carry the lowest price. This operation will be continued

from the lowest price to the next highest price contract until we reach a sales volume that is so small that it will not be advisable to operate a system of this magnitude.

508 I do not know when we will arrive at the point when it will no longer be economically feasible to operate the pipeline, because I do not know when or in what year we will be forced to curtail our sales volume due to lack of connected open flow, nor do I know the abandonment pressure that Texoma will eventually be forced to discontinue operations upon. The best that I can do is to indicate that following the time when Texoma is unable to supply the necessary production for this pipeline sales volume, it will be not more than three years before Texoma's rock pressures will have declined to a pressure of approximately 25 pounds. I mean three years from 1951. This determination is arrived at by careful analysis that has carried into an investigation of various matters connected with the Panhandle field, and I will describe this analysis in more detail later. My statement of three years from 1951 is based on the assumption that we will be able to go on with our full volume to that year.

If by reason of circumstances or contingencies which I have pointed out we reach the point prior to 1951 when we will no longer be able to deliver the full volume and we have to start curtailing our volume by cutting off the lower priced gas, then as to how long I think it will be from that time before the pressures will be pulled down to 25 pounds, if we are able to go that low, I will state that the analysis that was made to determine the period of declining sales volume that we might experience was made by assuming that Texoma would have sufficient open flow until 1951 and would be able to produce its wells down to 25 pounds. However, I indicated that as a practical matter I do not believe that Texoma is going to be able to keep all of its wells in producing condition, and that when the reservoir pressures decline to a pressure in the negihborhood of 150 pounds and the rate of production approaches 25% of the open flow of the well, the abandonments will increase and the rate of decline in the open flow will be accelerated because of changes in the producing formation brought about by salt water and the clogging of the formation. Consequently, it may be as much as two or three years prior to 1951 when Texoma's leaseholds will not be able to supply the necessary gas.

The figures I have given for the sales in 1936, 1937 and

1938 and my estimate of sales in the future were on a pressure base of 14.65, which is the pressure base employed in billing the gas.

The revenue received from the sale of natural gas by Natural Gas Pipeline Company for 1936 was $13,732,517.01; for 1937, $14,576,817.42; and for 1938, $13,769,434.41. The average for the three years is $14,026,256.28.

Breaking those figures down into the amounts received from the sale of firm gas and industrial gas for each of the three years and the average over the same period, the amounts are as follows:

In the year 1936, the firm revenue was $10,650,340.52, 509 and the industrial revenue, $3,082,176.49.

In the year 1937, the firm revenue was $10,801,601.78, and the industrial revenue, $3,775,215.64.

In the year 1938, the firm revenue was $10,699,948.88, and the industrial revenue, $3,069,485.53.

The average firm revenue was $10,717,297.06, and the average industrial revenue was $3,308,959.22.

I have an opinion as to the amount of revenue to be received by Natural Gas Pipeline Company during future years. My judgment as to the average annual revenue that the company can expect to receive from the sale of natural gas in those years when it has sufficient gas available is an average of the total revenue from sales for the past three years of 1936 to 1938 inclusive, or $14,026,256.28. That is the average for those three years.

My opinion is based upon the capacity of the present system and its efficiency and ability to deliver gas, upon the effects upon that equipment when it delivers the necessary volumes to produce this revenue, and upon my knowledge of the markets that I have gained as the result of a number of years of market negotiations with the utilities that are now purchasing this gas in the territory which we serve. I am certain that the capacity of the present system and the position now occupied by the utilities that purchase from us preclude this pipeline company from realizing larger annual revenues than the average of the past three years.

When we get to the point where we will not be able to deliver the full volume which has been estimated as our annual outlet, the annual revenue will decline as the sales volumes decline. As I mentioned previously, the lowest priced gas will be the sales that will be curtailed first. Consequently, the ratio between declining sales volume and

declining revenues will not have a direct relationship, but will be the result of delivering less volume of low priced gas than had been delivered in the past.

In stating the average figures for the period during which we can sell and deliver the total volume estimated, I do not mean to say that there will not be years when we will exceed that revenue. I am talking about the average annual revenue that this pipeline company can realize. We may have years in which the annual revenue will exceed the average, as we had in 1937; but we will also have years when the annual revenue will not equal the average, as we had in 1936 and 1938.

As between the gross revenues received from gas sold for domestic use and that sold for industrial uses, my judgment is that the average of the past three years represents an accurate division of the revenue between firm domestic contracts and industrial contracts. I do not see any opportunity to increase the sales for domestic use,
510 which carries a higher price, and a corresponding decrease in the gas sold for industrial uses. There will be variations in the volumes consumed by the domestic market; but the result of these variations will approximate the average of the past three years. We have, through intensive efforts, arrived at a point in the development of these markets which I feel represents the ultimate development that we can expect to realize in this territory.

I see no opportunity in the future to increase the volumes of gas sold for industrial uses at the higher prices, with a corresponding reduction in the gas sold for lower prices. The average of the revenue received from industrial sales during the past three years, in my judgment, represents the annual revenue that we can expect to realize year after year in the future from the sale of industrial gas. The reason this is true is that the capacity of the present system limits the total amount of gas that is available, and since the domestic markets have first call on the total quantity that is available, the only amount that can be sold in the industrial markets is the difference. The amount of natural gas that has been sold in the industrial markets at higher prices is, in my opinion, the maximum amount that should be sold; otherwise, the service to the higher priced industrial customers will be jeopardized and the entire situation become demoralized.

It is possible that prices for industrial gas will decrease. It is also possible that the prices to the customers may

increase; but I am talking about the revenue that we can expect to receive from the sale of these industrial volumes rather than the revenue that our purchaser receives in reselling this gas to the industrial consumer. In other words, I feel sure that we will be unable to raise our prices, and I think there is considerable question as to our ability to maintain the present contract price schedule.

I made a statement to the effect that if we undertook to increase the volume of gas sold in the higher brackets for industrial uses, we would endanger the quality of our service and might bring on a chaotic condition. I can illustrate that by describing the situation in the Chicago area. The total pipeline capacity available, after we serve the markets enroute to Chicago, is 185 million cubic feet per day. Our obligation to deliver under our firm domestic contracts with the Chicago District totals 126 million. This leaves a margi of 59 million pipeline capacity available to the Chicago area that can be resold in the industrial markets. In the industrial markets the contract negotiations and the sales efforts of our purchasers has resulted in the sale of this industrial gas to industries operating in the glass industry, industries operating in the steel industry, industries operating boiler plants, industries operating in the ceramic fields, and the price at which the industrial consumers in each of these industries purchase natural gas is related to the priority of service to which they are entitled. For instance, the glass industry pays the highest price and the boiler fuel customer pays the lowest price. In the event of a shortage of natural gas the boiler fuel customer is interrupted rather than the glass customer.

The total requirements of the glass and steel cus-
511 tomers, and all other industrial customers other than boiler fuel customers in the Chicago area, frequently range from 55 million to 62 million cubic feet per day. Therefore, if you contract to sell and deliver another 10 million cubic feet of gas per day to the glass customers or the steel customers, the total requirements of those customers will be in excess of the 59 million cubic feet of pipeline capacity that is available. Consequently, the service to some of those customers in that price class will be unsatisfactory and they would not be interested in paying the prices they are now paying if the service was going to be of an interruptible nature or become of a nature that the service is to the boiler fuel customers. The price

would either decline or the customer would not accept delivery of the service.

There has been an increase in the price at which we have sold gas in the past and the price at which we are now selling gas for industrial purposes; but the fact that we now have higher prices for industrial gas than we had in earlier years is not indicative of an increase in the price trend. As I mentioned earlier, we have had prices for industrial gas that were concession prices and were made for limited periods of time for specific reasons. They were the result of long prolonged negotiations, and in these negotiations were involved capital expenditures on the part of the utility company and capital expenditures on the part of the industrial consumer. We have now passed out of the period when the special prices were made as concessions or made as inducements to accelerate the attachment of the industrial market, and my judgment as to the future revenue to be received from the sale of industrial gas is based upon the assumption that the present contract prices for industrial gas will continue in effect. This may be difficult to accomplish since we have pending the renewal of fifteen of these industrial contracts in 1939. Some of these renewals are with the Chicago District Pipeline Company, and I sense from my contracts with them that we may have difficulty in maintaining the present prices.

The industrial contracts that expire in 1939 are fifteen in number, and the last expiration date in the group is December 31, 1939. We will endeavor to renew these contracts at the first opportunity, but up to now have given preference to the preparation of the presentation of the evidence in this hearing. In other words, we are running behind schedule on negotiations.

I have referred to the decline in pressures in the Panhandle gas field and some of the problems that attend these declines. The effect of this is that as the rock pressure of a well declines, the open flow or the ability of that well to produce gas also declines. They do not decline at the same rate. Wells in different fields vary or have different characteristics, and wells in the same field vary. However, in the Panhandle field the open flow or producing capacity of a well declines more rapidly than the rock pressure. By that I mean, starting with any given rock pressure and open flow for a particular well, when 10% of the rock pressure is gone, more than 10% of the open

flow is gone. That is true of the entire field, so far as I know. I do not believe there are any exceptions in the Panhandle field.

512 It is possible for those in the engineering profession to predict with reasonable accuracy the future course of the pressure decline and the potential producing capacity of the wells in the future, provided it is done properly. In the case of Texoma's wells this problem is complicated because of the drainage that Texoma has experienced in the past and is continuing to experience. Consequently, the rock pressure decline is not due to its own production alone. The Bureau of Mines has developed what is known as the back pressure method of testing a gas well. This method or principle when properly used will give the open flow that can be expected of any well at any future rock pressure. The principle is perfectly sound, but is based on certain theoretical assumptions, particularly that there be no change in the producing formation and that there be no change in the drainage area of the well. Consequently, in actual practice any determination in regard to the open flow or the producing capacity of a well in the future is less than the calculated amount as determined by the black pressure method if any of the assumptions on which the method or principle is based have not been fulfilled.

As to the potential producing capacity at future pressure levels indicated by these pressure decline tests, and whether or not it is more or less than that which is actually calculated to be realized in view of the assumptions that must be indulged in figuring these back pressure curves or making these back pressure tests, in actual practice it usually happens that the actual open flow realized at some later date is less than the calculated indicated open flow by the back pressure method. This may occur very early in the life of a well or it may occur later; but Texoma has observed on some of its wells already that the ability of these wells to produce is less than previous back pressure tests indicated it would be at the rock pressures that now exist.

An intrusion of salt water resulting in a salting up of the formation, or a caving in of the producing formation, or a bridging of the producing formation, operates to reduce the potential open flow at a given future pressure below that which is indicated by the pressure decline test.

As I previously stated, the calculated open flow as determined by the back pressure method will be realized only when there is no change in the producing formation, no change in the mechanical condition of the well, and no change in the drainage area of the well.

Counsel assumes that the number of wells be increased to where a well which is now draining an area for a mile around it has a well drilled within a mile of its location, and inquires as to the effect on the future potential producing capacity, in comparison with pressure, as indicated by the pressure decline curve, the drilling of that additional well will have. If there is no change in the rate of producing the first well before the drilling of the second and no change after the drilling of the second, and if the second well is produced at a sufficient rate, then it is to be expected that it would affect the producing area of the first well by having the first well decline in open flow at a more rapid rate than would have been the case had the second well not been drilled.

I have caused an investigation to be made through which I have sought to arrive at the future pressures of Texoma's wells and the capacity of those wells to produce gas over the period of the next ten or fifteen
513 years.

I mentioned previously the amount of work that myself and others in this organization have done in regard to the development of facts pertaining to the Panhandle field in connection with the five major lawsuits in which Texoma has been involved in the State of Texas. In connection with some of this work we were concerned with rock pressure conditions and open flow conditions and the trends into the future. This work was handled between 1932 and 1936, or possibly later. Also, from time to time Mr. Floyd C. Brown has discussed with me and urged that I undertake to determine the full and complete future development program of Texoma Natural Gas Company and to determine the future capital needs of both of these companies, not only for development but for all other purposes, to investigate what capital would be required for replacement, and to study the trend of future operating and maintenance expenses.

Since Texoma's development program was such a large part of the total future capital that was going to be required, I attempted to solve this problem with the assist-

ance of geologists, production engineers, and others, a number of times.

The problem is not as simple as it appears on its face. Texoma's present rock pressures are the result not only of its own production but of drainage away from its leases and drainage into its leases. In the future Texoma is going to be drained in a similar manner. As a result of this, Texoma's annual production requirements related to its total gas reserves under its own leaseholds was not a true index of the number of years that it could expect to produce gas in those quantities. Even today Texoma's reserves related to its current and annual production requirements is not a true index of the number of years that Texoma can expect to produce the required volumes of gas.

Therefore, it appeared advisable to me to determine the total reserves, the total recoverable reserves, of the whole field, and to determine the annua withdrawals that would occur from this field in the future, and to combine this information with the data which Texoma had on its own wells in order to decide on the future course of the rock pressures of Texoma's wells. I am referring now to the rock pressures of Texoma's present wells and also the rock pressures of the wells that will be drilled by Texoma in the future, and the course that the decline of the rock pressure of these wells will take.

It also appeared advisable to carry with this analysis a determination of the total number of wells that Texoma should drill. Since the producing capacity of wells declines as the rock pressure declines, but not necessarily at the same rate, it is obvious that if Texoma does not drill it will be short of open flow earlier than it will if it does drill additional wells. If it drills only a small number of additional wells, the day when it will be handicapped by lack of open flow is delayed. If it drills a large number of additional wells we might delay the day when there is a deficiency in connected open flow even longer. Consequently, the query arises as to how many wells Texoma can afford to drill and will all of these wells be economical.

By that I mean, will these wells drilled in later years
514 produce enough gas and will the revenue received from the sale of this additional volume of gas be sufficient to pay for the operation and maintenance expense of getting that gas to market and to amortize the addi-

tional capital that the drilling of the additional wells brought about.

I also mean to include not only the additional capital of the additional well, but the lateral line, the meter setting, and the booster station, if the additional drilling affects the amount of booster power that must be installed.

The analysis cannot be properly carried out unless it is co-ordinated with the sales price that is to be received from the gas and the sales volume that can be sold year after year.

In the early years, referring to from 1932 to 1936, it was almost impossible to make any progress with the production phase of this problem, because of the erratic policy of the State of Texas in regard to the conservation of oil and gas, particularly in the Texas Panhandle gas field. However, by 1936 it appeared, to me, at least, that conditions were becoming somewhat stabilized. I reached this conclusion because of the verdict of the Federal Court and the findings of fact contained in that verdict in a case which Texoma and others had, and which was decided in the Federal Court in the year 1936, I believe in the month of April. That was the case of Consolidated *vs.* Thompson, reported in 300 U. S.

Since it appeared to me that conditions were becoming somewhat stabilized in the field, I began to work on this problem more intensively, particularly the production end of it.

Later, about 1937, I began to see publicity pertaining to the consideration that Congress was giving to legislation then known as the Lea Bill. In my supervisory capacity with the company I had occasion to read this bill and consider what it might mean to the two companies by which I was employed. By 1938 it appeared to me that we would have legislation of this form, which we later did, being the Natural Gas Act, which was passed in June of 1938.

Also early in 1938 Natural Gas Pipeline Company intervened in a hearing before the Illinois Commerce Commission. Because of the situation confronting us in 1938, it appeared to me that we were going to need a complete economic analysis of both of these companies, not only for the purposes Mr. Brown had in mind but for the purposes of meeting the situation presented by the Natural Gas Act. It seemed to me that this situation called for

an economic analysis that involved the future sales revenues, future sales volumes, future operation and maintenance expenses, the number of years that these revenues could be realized, the future needs for capital, for additions to the system, and for replacements to the system, in order to fix more accurately the total requirements of this system for future capital for these various purposes, and to fix more accurately the future earning power of the company.

Therefore, early in 1938, I started arranging the 515 organization under my supervision for the purpose of working on this problem. I selected Mr. R. M. Bussard, the head of the special problems division in the engineering department, to take general charge of this study and to prepare certain phases of it himself. I supplied Mr. Bussard with assistants from the engineering department, from the drafting room, and various operating heads. I asked Mr. G. M. Davidson, chief engineer and superintendent of operations, to assist Mr. Bussard in general, particularly by conferring with the operating heads on the assignments that I was going to give them, and that he should devote sufficient time to a study of the natural gasoline market in order to arrive at the future course of the market price for natural gasoline, and, when the future production volumes were available, to determine the amount of natural gasoline this company could expect to produce if those volumes of gas were produced.

I spoke to Mr. J. G. Dickinson, Mr. C. J. Peterson and Mr. C. C. Kuhne in regard to helping Mr. Bussard on various phases of this problem that had to do with the present reserves in the Panhandle field in total and Texonia's present reserves, geological conditions, future withdrawals, future development work, and certain production engineering problems.

I selected various operating heads to cooperate in this study. Mr. R. T. Powers, the superintendent of the Fritch compressor and gasoline plant, was assigned the duty of working out his future operating expenses, his future replacements and his future additions to plants.

I selected Mr. R. G. Strong, superintendent of pipe lines, to prepare this same type of study for the gathering system, including the booster stations and the main transmission system.

I selected Mr. W. H. Davidson to do the same thing for the compressor stations on the system of the Natural Gas Pipeline Company of America.

I selected Mr. W. T. Bulla to prepare the projection for the telephone and pressure dispatching division.

I conferred with Mr. S. E. Campbell, secretary of the company, in regard to making available to Mr. Bussard certain help from the accounting department and asked him to cooperate on certain phases of this work particularly the general overheads and future taxation.

These operating heads I have referred to have been relieved of their routine duties from time to time, and in recent months have been completely relieved of their routine duties and have devoted their entire time to this matter.

I also supplied Mr. Bussard with the assistance of two outside consulting engineers to help on certain phases of this problem. These engineers were Mr. Stanley Gill and Mr. P. McDonald Biddison.

Mr. Bussard and the other assistants under him have worked constantly on this matter since early in 1938.

516 As I have mentioned, in recent months the operating heads I have named have devoted their entire time to this matter.

As a result of that circumstance we have been handicapped in certain features, particularly in contract negotiations, and we have been handicapped in the development of certain design work, which has resulted in the capital expenditures that we had scheduled for this year running at a slightly lower rate than they normally would. However, I do not foresee now that it means we will not eventually before the year is over accomplish the replacements and the additions and the maintenance that we had scheduled for this year.

In the making of this long study involving the whole economic setup of these companies I have supervised the work from its inception. I had many conferences with Mr. Bussard, Mr. G. M. Davidson, and all the other operating heads, and I have had conferences with the two outside consulting engineers that I mentioned. I have watched the development of this work. I have reviewed the various component parts of it as it was put together from month to month during the past two years or year and a half.

I am familiar with the studies prepared by Mr. Bussard

and those who are assisting him, and with the results of those studies, and with the exhibits which they will bring into this hearing during the further course of these proceedings.

I am in accord with the conclusions that Mr. Bussard and these department heads and others have reached, and which they are going to present here through these exhibits and studies, with this reservation: In order to carry these calculations to a conclusion, certain assumptions were made. For instance, the present wage scales that now exist are carried forward into the future. The present rates of taxation are carried into the future. Certain assumptions were made in regard to the decline in the producing capacity of Texoma's wells. It was necessary to make these assumptions as a basis of calculation. However, it is my judgment that the result of these calculations is overly optimistic. It seems to me that there are many contingencies confronting these two companies that are not reflected in these calculations and could not be reflected in them and still have them be called calculations; that the results of this work must be read in the light of the assumptions made; and that the results must be modified by practical judgment. I feel that the result of this future projection is too optimistic.

Cross-Examination by Mr. Slaff.

I have testified in no cases in the last five or six years. I recall being on the stand two times, about 1921. That was not a rate case. About 1921 I identified a water sample in the Federal Court, I think, at Oklahoma City. I was on the stand in Federal Court in Tulsa, Oklahoma, in the case of Henry L. Lemons *vs.* Natural Gas Pipeline Company of America, in which the contractor was suing us for extras
517 amounting to in the neighborhood of one million dollars. I have not testified in any rate cases.

As I recall my testimony in the Lemons case, I identified the contract; I described the location of the work; I described the specifications and how our supervision of the execution of the work was carried out under the specifications. I may have described conversations and negotiations that I had with this contractor after completing the work in an endeavor to settle his claims for extras; but I am not sure of this.

Questions by the Examiner.

The heavy capital expenditures increase in 1935 and 1936 is a result of more than one thing. The amount of money expended for the drilling of gas wells in 1935 was $319,962.60, while the amount for the same purpose in the previous year was only $57,789.59. In 1936 the amount expended for the same purpose was $299,727.89.

For gathering lines the expenditures increased from $14,745.72 in 1934 to $247,093.72 in 1935 and $83,238.05 in 1936.

The expenditures for additions to plant in the classification that we call main lines, meaning the main transmission system, increased from $4,114.86 in 1934 to $247,497.61 in 1935, and $211,237.58 in 1936.

The expenditures for additions to compressor stations increased from $142,268.12 in 1934 to $417,480.98 in 1935, and $422,113.48 in 1936.

The capital expenditures that I have mentioned are the ones where the major variations occur, but there is no uniformity in the capital expenditures from year to year for other investment classifications. They vary by increasing and decreasing. I have mentioned the main items that brought about the accumulated increase.

Cross-Examination by Mr. Booth.

The following table shows gross capital expenditures of the companies in the years referred to:

Natural Gas Pipeline Company of America
and
Texoma Natural Gas Company
Gross Expenditures for Additions to Plant.

	1932
Lands in fee	$ 1,331.76
Leaseholds	21,986.00
Rights of way	47,348.12
Gas wells	262,370.29
Gathering lines	94,506.32
Main lines	9,826.10
518 Compressor stations	42,625.29
Gasoline plant	20,770.75
Telephone system	770.76
Meters and regulators	10,885.61
Other main line structures	5,593.38
Branch lines	6,489.09
Drilling and clean-out tools	—0—
Tools	1,364.39
General laboratory equipment	—0—
Automotive equipment	28,249.59
Furniture and fixtures	4,318.01
Booster stations	—0—
Total	$ 558,435.46

	1933
Lands in fee	$ 558.36
Leaseholds	7,692.00
Rights of way	27,605.35
Gas wells	123,452.45
Gathering lines	15,532.67
Main lines	1,488.82
Compressor stations	4,457.20
Gasoline plant	5,936.46
Telephone system	—0—
Meters and regulators	2,444.78
Other main line structures	2,951.87
Branch lines	111,362.57
Drilling & Clean-out tools	—0—
Tools	1,354.70
General laboratory equipment	534.32
Automotive equipment	15,956.27
Furniture and fixtures	3,993.35
Booster stations	—0—
Total	$ 325,321.67

	1934
Lands in fee	$ 222.15
Leaseholds	10.00
Rights of way	5,723.07
Gas wells	57,789.59
Gathering lines	14,745.72
Main lines	4,114.86
Compressor stations	142,268.12
Gasoline plant	38,402.71
Telephone system	961.59
Meters and regulators	3,374.70
Other main line structures	1,915.66
Branch lines	9,969.67
Drilling and clean-out tools	—0—
519 Tools	1,049.51
General laboratory equipment	170.74
Automotive equipment	26,420.64
Furniture and fixtures	2,733.80
Booster stations	—0—
Total	$ 309,872.53

	1935
Lands in fee	$ —0—
Leaseholds	9,351.00
Rights of way	2,039.93
Gas wells	319,962.60
Gathering lines	247,093.72
Main lines	247,497.61
Compressor stations	417,480.98
Gasoline plant	33,268.38
Telephone system	3,380.95
Meters and regulators	3,380.23
Other main line structures	2,306.75
Branch lines	2,934.31
Drilling and clean-out tools	790.79
Tools	4,413.06
General laboratory equipment	—0—
Automotive equipment	30,236.66
Furniture and fixtures	2,943.23
Booster stations	—0—
Total	$1,327,080.20

	1936
Lands in fee	$ 314.77
Leaseholds	3,734.23
Rights of way	9,223.47
Gas wells	299,727.89
Gathering lines	83,238.05
Main lines	211,237.58
Compressor stations	422,1[illegible].48
Gasoline plant	22,311.07
Telephone system	2,385.67
Meters and regulators	5,990.44
Other main line structures	15,403.04
Branch lines	9,018.22
Drilling and clean-out tools	2,527.53
Tools	6,265.90
General laboratory equipment	—0—
Automotive equipment	31,555.99
Furniture and fixtures	6,068.25
Booster stations	—0—
Total	$1,131,145.58

520

	1937
Lands in fee	$ 6,951.25
Leaseholds	51.00
Rights of way	3,287.89
Gas wells	246,616.19
Gathering lines	75,705.02
Main lines	132,637.49
Compressor stations	160,056.12
Gasoline plant	23,028.05
Telephone system	2,701.95
Meters and regulators	2,334.37
Other main line structures	3,616.99
Branch lines	1,578.10
Drilling and clean-out tools	1,189.53
Tools	11,893.73
General laboratory equipment	—0—
Automotive equipment	31,853.34
Furniture and fixtures	6,317.93
Booster stations	—0—
Total	$ 709,818.95

	1938
Lands in fee	$ —0—
Leaseholds	46,994.26
Rights of way	6,904.10
Gas wells	284,528.21
Gatherin lines	62,726.08
Main lines	288,571.13
Compressor stations	212,818.79
Gasoline plant	5,915.95
Telephone system	5,234.40
Meters and regulators	2,487.94
Other main line structures	8,884.54
Branch lines	151.61
Drilling and clean-out tools	—0—
Tools	43,201.87
General laboratory equipment	82.14
Automotive equipment	60,345.88
Furniture and fixtures	5,751.26
Booster stations	6,796.70
Total	$1,041,394.86
Grand Total	$5,403,069.25
Avg./Year	$ 771,867.03

521 *Questions by the Examiner.*

The six wells which I stated would have to be plugged in the next two or three years are in Gray County, in the general area where we have already plugged eight wells. It is sometimes referred to as the Lefors area. It is south of Lefors.

The analysis which I said would be given here later on rock pressure drops will go in by another witness. There are so many phases of this problem that each phase has been prepared by the operating heads responsible for these particular departments and functions, and they are the best qualified men to testify in regard to each particular part. The reference I made was to one phase of the complete analysis which will be covered by another witness.

Redirect Examination by Mr. Morgan.

At the time Texoma's gathering system was constructed I took steps to build the line on down to Wheeler County, where these wells are now connected to Lone Star, and past where the wells connected to Coltexo are located.

The layout of the main 24 inch trunk that forms the main artery of the gathering system was developed under my supervision, and when we awarded the contract for the construction of all that part of the gathering system which contains 24 inch pipe, we included the necessary 24 inch pipe to extend into Wheeler County. That contract had been awarded.

I was in Texas, going over the field before actual construction started. From the impressions that I obtained while in the Texas Panhandle and after considering the matter, I returned to Kansas City and recommended to Mr. Brown that we defer constructing the gathering system beyond a certain point in Gray County. Mr. Brown agreed, and I contacted the contractor that held the contract for the construction of the 24 inch gathering system and arranged to modify the original contract to exclude the 24 inch trunk that had been included and which was for the purpose of extending across Gray County and on into Wheeler County.

The modified contract as finally carried out covered the entire 24 inch gathering system as it exists today. After deferring the construction of the gathering system into

Wheeler County, we later decided not to construct the extension beyond where it now lies.

The considerations entering into our decision were that the cost of the part of the gathering system which was excluded from the contract then in effect and the cost of the lateral lines to connect the wells in central Gray County and the nine wells that we then owned in Wheeler County appeared to me to be excessive—in fact, the cost of this extension was slightly under one million dollars—and I thought it advisable to defer making this expenditure until it was clear that the extension would be needed. Later developments in the field made it inadvisable to make the extension.

522 As to how far we would have had to extend our 24 inch main gathering line in order to reach the central producing area in Wheeler County, the mileage that I had contracted and which was excluded from the contract before the gathering system was constructed was 29 miles of 24 inch line. As a result of that modification we eliminated an expenditure of $781,000 from that contract.

In addition to that we eliminated the cost of the lateral lines, and the meters, that would have been necessary to connect the wells in central Gray County and the wells in Wheeler County to this 24 inch trunk; but these facilities were not included in the contract to which I refer. We also eliminated the cost of a booster station that would have been necessary in the Gray County area very shortly because of the pressure conditions that existed. The approximate cost of the lateral lines and meters was $97,400, and the approximate cost of the booster station was $69,000, making a grand total of $947,000.

Cross-Examination by Mr. Booth.

Counsel inquires whether an 8 or 10 inch line would not have been sufficient to reach the wells in that area, instead of a 24 inch line. My answer is that an 8 or 10 inch line, or even a two inch line, would have been sufficient to reach the wells in that area, assuming that the line was long enough. As to whether an 8 or 10 inch line would have been adequate to take care of the gas produced in those wells, we were not designing this gathering system for the wells that Texoma then owned in the Panhandle field. We were designing it to serve the wells that it then owned,

plus the wells that it intended to drill to produce the gas from its gas reserves. That is true of the portion of the system that was planned for Wheeler County, the system that was planned for Moore County, and the system that was planned for Carson County.

The question of whether or not an eight or ten inch line would have been adequate to serve all of the wells and the entire gas reserves in that area brings me to the consideration of all the acreage that Texoma owned in Wheeler County and Gray County, and I do not have those quantities in mind at the present time. It also brings into consideration the quantities of gas that would be produced and carried through the same 24 inch trunk that led west from Gray County to the Fritch station.

I did not make the statement that the 29 miles of line was intended to serve only the few wells which were used in supplying natural gas to the Lone Star Gas Company and the Coltexo Corporation.

Questions by the Examiner.

This morning when I was testifying in regard to deferring an expenditure, I was referring to the portion of the gathering system that we eliminated from the contract that I have just mentioned, and the additional investment that would be required to make that extension useful, and the booster station that would be required in the later years in operating those wells. I did not intend at any time this morning to say that we had ever determined or had a figure in mind that was confined only to the wells that we now own in Wheeler County, or that we then owned in Wheeler County, when we made our decision to defer building into Wheeler County.

We owned a lot of other acreage down in Wheeler County and in eastern Gray County at that time.

(Colloquy by the Examiner and all counsel with respect to time necessary in recessing hearing.)

523 R. M. BUSSARD, a witness for defendants, testified as follows:

Direct Examination by Mr. Morgan.

(July 26, 1939)

My name is R. M. Bussard. I live in Highland Park, Illinois. I am employed by Natural Gas Pipeline Company of America and Texoma Natural Gas Company, and work in their offices at 20 North Wacker Drive, Chicago, Illinois. I have been employed by these two companies since their organization, and prior to that time by the Continental Construction Corporation.

I received my technical training at Purdue University, from which I graduated in June, 1923, with the degree of Bachelor of Science in mechanical engineering. Following my graduation, I went to Bartlesville, Oklahoma, where I obtained employment with the Empire Companies in their Junior Engineering Course. I continued with the Empire Companies and their affiliates, with the exception of one short interval, until I came with the Continental Construction Corporation, which was about July, 1930.

The Junior Engineering Course of the Empire Companies is designed to give the newly graduated engineer a two year course of training in the company. The engineer moves from department to department in the company and thereby completes his general education and obtains experience in the oil and gas business. My first assignment on the Junior Engineering Course was in the job order closing work of the natural gasoline department.

About July, 1923, I went to Sallyards, Kansas, where the company was constructing a natural gasoline plant, and there had charge of the construction office work. I took care of the payroll and the distribution of the payroll charges in the various parts of the job and I also kept track of the material and the places in which it was used throughout the plant.

About November, 1923, I went to Winfield, Kansas, with the Distribution Company there, which was one of the Empire Companies. In Winfield I did work on the distribution system, particularly in regard to the leakage testing of the system and the repair work. I also did some work in the customers office of the company.

The first of the year 1924 I moved to Eldorado, Kansas. My work there was to inspect the appliances in the commercial kitchens and the appliances of other commercial users of natural gas in Eldorado. I also estimated the house heating bills for various prospective house heating customers and made installation of the house heating equipment when the customer decided to purchase it.

I left the Junior Engineering Course while in Eldo-
524 rado, about May of 1924, and then went into the distribution department of the Eldorado Company, again doing leakage survey and repair work.

Early in the summer of 1924 I moved to Ottawa, Kansas. This was the headquarters town for a group of properties which had just been acquired. The group extended down the eastern part of Kansas. I had local charge of the leakage repair work in several small towns in this group which had just been purchased. There were no maps available, so we had to locate the property, conduct our tests, make the repairs, and make the necessary reports as to what we had found and what we had done to make the repairs and also report as to the condition of the system after we had made the repairs.

Late in 1924 I went to the Johnson County Gas Company, which is located in the suburban area of Kansas City, Kansas. This company was growing very rapidly, because of the large amount of suburban building, so that their job order work was much behind. I brought this work up to date and spent some time with the personnel that had charge of the customers' office.

A job order is a part of our paper work, in which we state the work to be done and make a request for permission to do the work. We describe the work and also the costs involved, and then as the work progresses the costs are accumulated against the particular order number and in the end we then have a cost accounting for the particular job that was done. The job orders are taken out for all types of construction work.

Early in 1925 I went to Bartlesville, Oklahoma, where I made a check on the capacity of a portion of the Cities Service Gas Pipeline Company system. This is one of the Empire Companies.

I then went to New York City, to the office of the man who had charge of the natural gas and natural gasoline activities of Henry L. Doherty & Company. This man's name is J. D. Creveling, and he is now president of the

Panhandle Eastern Pipe Line Company. I did a considerable amount of traveling under Mr. Creveling's supervision, and eventually reached all or practically all of the natural gas properties of the Henry L. Doherty & Company.

Some of the work which I did in traveling around from property to property related to market analyses and some related to determination of cost of construction of specific pieces of property, and various special problems that he would assign me to do. One of the first special problems was in Hamilton, Ontario, where one of the Doherty Companies desired to expand its distribution system and wanted to know the number of houses that they might expect to get connected to the system and the probable load that would be accumulated thereby.

Another problem had to do with a number of properties in Kansas. These properties had been recently purchased and Mr. Creveling desired that I make a change of their cost classification as to operation and maintenance over to the Henry L. Doherty & Company classification in
525 order that we might have some comparative figures to see whether Doherty's operation was as profitable or more profitable than the former owners.

During 1926 I assisted in the preparation of the first market study on Denver, Colorado, and the adjacent area. The cause of this study was the fact that Mr. Minal Young was proposing to build a pipe line from the Texas Panhandle to Denver and towns enroute. The reason that I went to this particular property was that Doherty & Company owned the Denver gas distribution system, and also owned the Pueblo, Colorado, system and the Boulder, Colorado, system, and the system of other towns in that vicinity, including Fort Collins and Cheyenne, Wyoming.

While I was in Denver on this particular job, I was sent to Grand Junction, Colorado, to report on the feasibility of taking natural gas from the Gar Mesa structure. The town was served by manufactured gas at the time, and I prepared my report in reference to this property and recommended that there be nothing done about the local gas situation.

While we were in Denver I also did some work on the Colorado-Wyoming Gas Company, another Doherty subsidiary, which had constructed a pipeline from a local gas field to Fort Collins and, at the time I was in Denver, was constructing a pipeline from this field to Cheyenne, Wyoming.

The next major assignment to which Mr. Creveling sent me was the Arkansas Natural Gas Corporation. The name today is Arkansas-Louisiana Gas Company. We were concerned not only with the Arkansas Company and its property, but also with some other companies in the general Shreveport area. In fact, Doherty owned a gas distribution property and production property in Eldorado, Arkansas.

The first work done on the Arkansas Natural Gas Company assignment was at Pittsburgh, Pennsylvania, where I made in the company's office a general study of the capital structure, the property of the company, its income, its operation and maintenance expense, and the net results obtained by the company.

A little later we went to Shreveport, Louisiana, and studied some small companies in that area which we thought might be combined with the Arkansas Company. We also made a market study of the Arkansas Natural Gas Company and traveled through its properties in order to see the market possibilities. I compiled a report relating to the entire situation and, of course, presented it to Mr. Creveling. The property was finally acquired by the Doherty Company and the various mergers were made—not all the mergers that we contemplated, but a considerable number of them.

Early in 1929 I worked on a study of the Southern Natural Gas Company. This company was projecting a line from the Richland Parish and Monroe fields in Louisiana to Birmingham and Atlanta. My particular work on this assignment related to the distribution companies, their ownership, the number of customers, the amount of sales, and the other information that would enable one to get a general picture of the domestic market in the area. To get this information I, of course, had to call on various commission officers and the other places to which we
526 normally go to get information without directly contacting the companies themselves. That was in the area of Birmingham and Atlanta. That line has been built and is the Southern Natural Gas Company.

In July, 1929, I left the direct employment of Henry L. Doherty & Company and went to one of its subsidiaries, the Colorado-Wyoming Gas Company, whose offices were in Denver, Colorado. My first work there was to account for the materials that were being used in a pipeline which the company was constructing from the vicin-

ity of Denver, Colorado, to Fort Collins, Colorado, to take care of Fort Collins and Cheyenne, Wyoming, and other towns in Colorado. That work relating to materials, of course, meant keeping track of the stuff from the time it left the plant to the time it was in the ground.

While I was with the Colorado-Wyoming Company I made a trip to Salt Lake City, Utah, to obtain some information for Mr. Kesinger relating to some construction problems of the Uintah Pipeline Company, which had constructed a system from approximately the northwestern part of Colorado to Salt Lake City, serving Salt Lake and projecting service to other towns in the area.

Also while with the Colorado-Wyoming Gas Company I went to Laramie, Wyoming, and investigated the possibilities of the Colorado-Wyoming Company extending its service to Laramie. I made a study during this same period of the amount of error that was occurring in the Colorado-Wyoming Company's orifice meters, these meters being the ones they purchased gas through in the local field near Fort Collins. The company's compressor station was so close to the point of measurement that there was a disturbance on the meter charts. We determined the amount of this disturbance and then checked back through all the charts and arrived at a correction bill.

I should mention that I made a study in Pueblo, Colorado, relating to the new business department in Pueblo and to the market possibilities.

About the time I finished with the measurement problem, the company proposed to build an extension of its system from Johnstown, Colorado, to Greeley, Colorado, and I was instructed to lay out the right of way, obtain the right of way, and supervise the construction of the line, but I received a call from Mr. Creveling asking if I could spend some time in Chicago to check over some market studies that had been made of the area outside of the Chicago metropolitan area. That was in May, 1930. I came to Chicago with the expectation of spending only two weeks, but the job lasted a good deal longer than that. I never got back to Denver, and am still here.

I was assigned to regular duty with Continental Construction Corporation in July or August, 1930. I do not have the exact date. I became a member of the staff of Mr. N. D. Holman, who had charge of what was termed

the Chicago marketing office, and was specifically assigned to the duties of office engineer, correlating the field studies made by other engineers as to the markets. Also I
527 conducted some field studies myself and had a number of men in the principal towns in the eastern part of Iowa, which would be contiguous to the pipeline that was being projected, which is the same line that is now owned by Natural Gas Pipeline Company of America. My work in Chicago had to do with this system from the time I first came here, when I thought it would be a temporary assignment.

With the exception of two special problems that Mr. Creveling asked me to do, I stayed under the supervision of Mr. Holman for approximately a year. Mr. Creveling asked that I go to Albuquerque, New Mexico, to study the Southern Union Gas Company project to take gas to Albuquerque and other towns in that area. He also later requested that I go to the Consolidated Gas Utilities Company, which takes production from the Texas Panhandle field and from points in Oklahoma, and finds some of its markets in Oklahoma and others in Wichita, Kansas, and vicinity. These special assignments at the request of Mr. Creveling were carried out prior to the moving of the Continental Construction Corporation offices to Chicago.

When the office was moved to Chicago and the two companies, Natural Gas Pipeline Company of America and Texoma Natural Gas Company, began their operations I was assigned to the office of those companies here in Chicago. For a few months after the Kansas City offices came to Chicago I remained in the marketing work, but was then transferred to the engineering department. Practically all the work that I have done in the engineering department has related to special problems of one kind or another. These special problems were received either from Mr. G. M. Davidson, chief engineer, or Mr. E. V. Kesinger, the general superintendent, and I will discuss some of them.

Right at the beginning of the year 1935 I prepared a report referred to as the Rayburn report. Mr. Rayburn was a member of Congress from Texas and was chairman of the Interstate Commerce Committee of the House of Representatives. We gave the report that name because we hoped to make this information available to his committee, and at the time the Cole sub-committee was in

existence we thought this information would be useful. My understanding is that the Cole Committee was a subcommittee of the Interstate Commerce Committee of the House of Representatives at Washington. The information in the report related to the situation in the Texas Panhandle field and the various problems we were faced with there.

Another problem which was more routine in nature was the preparation of the annual sales and revenues budget of Natural Gas Pipeline Company. I have also made studies relating to the quantity of industrial gas service that was discontinued because of insufficient capacity in the system.

I made several studies brought about by the various revenue acts which called for the company to make a declaration of its capital stock value. These revenue acts also brought into question the undistributed profits tax, and my studies endeavored to determine the proper capital stock value and also the amounts of undistributed
528 profits tax which the company might have to pay.

I prepared a report relating to the general fuel consumption situation in the State of Illinois. This was prepared in connection with one of the proposals to impose a state tax upon the sale of natural gas within the state. Late in 1933 and early in 1934 I did work with the natural gas executives who were studying the preparation of the natural gas code in the National Recovery Administration.

I have made a study relating to the economic method of boosting the field pressures when the time comes in the Texas Panhandle when pressures are inadequate to cause the gas to flow properly into the system of Texoma.

About two years ago I made a study relating to the steam turbine versus gas driven gas compressors. At the time I did this work the steam turbine driven compressor for gas compression use was having a temporary flurry and Mr. Davidson, the chief engineer, asked me to make a rather brief report relating to the possible economics in our own situation. My conclusion was that the gas driven engine or gas compressor was still the most suitable, all the various features being considered.

I made a study of the economics that would result if we would treat the fuel for the Fritch compressor station

engines for the extraction of the gasoline content prior to the use of this gas as fuel in the engines.

I have also determined the revenue effect to the Natural Gas Pipeline Company of the application of the new measurment procedures outlined by the Measurement Committee of the American Gas Association.

I made a report as to depreciation for income tax purposes.

In collaboration with Mr. Davidson, the chief engineer, I prepared a paper on natural gas transmission problems. This paper was sent to the American Gas Association, where it was combined with other papers relating to natural gas and was a part of the proceedings of the third World Power Conference.

I think the most important assignment that I have had with the company is the particular one that I am on now, namely, the one that relates to the future economic life of Natural Gas Pipeline Company and Texoma. I have worked on various phases of this problem since 1936, but it was early in 1938 when the assignment was specifically made on this general entire problem.

In addition to my engineering training and experience, I have engaged in another line of technical study not specifically of a engineering nature. My contacts were so frequent with the accounting functions of various companies and, of course, of my own companies, that I have taken and about completed the LaSalle Extension University course in accounting. I would have had that done if it had not been for this particular assignment.

529 Mr. Kesinger directed me to start work on the present problem which I have at hand. This was early in 1938, I think about February, and I was then directed to spend my entire time in connection with this study.

Mr. Kesinger told me that inasmuch as it was evident that we would need to make a complete analysis of the economic future of the two companies, and of all the elements involved in such a determination, I should proceed to prepare myself to make that study, and to keep in mind that the specific answer to be obtained was the future economic life and the earnings possibility of the companies during that period of time.

There are several important elements in a problem of this nature. We have to determine the quantity of additional property that will be needed to carry on the busi-

ness of the company, and, of course, we would have to determine the construction cost of that property. We would have to determine the cost of replacement of the existing property as particular portions might wear out and become no longer useful. We would have to determine the operation and maintenance costs of the present property and of any additional property that would be needed.

We would have to study the revenue to be obtained during the future and the quantity of sales that would produce the revenue. We would have to determine the general expenses of the company, and, of course, the taxes and expenses of that nature.

In thinking of the probable expenditures in the future for additions to present property, replacements of existing property and the maintenance and operating expenses incident to carrying on the operations of the company, I was not able to confine my studies to the leasehold interests of Texoma in the Panhandle field. The leasehold situation in the Panhandle field and the wells to be drilled thereon were an important element, of course; but if we stopped solely at the future well drilling we would not get anywhere near the entire picture. We would have to go on and determine the gathering system that would be involved and all the meters and regulators, and all the facilities, and then we would have to proceed to study the compressor stations that existed on the system and see what replacements would be required there and what additions to capital would be required, and what their future operation and maintenance would be.

Similarly, we would have to study the main line departments of the company to see what they would need in capital and operation and maintenance and in replacement costs. In each of these various divisions we would have to give particular attention to their own peculiar problems. We would have to consider the branch lines of the company and replacements that might be needed to be made there. We would also have to study the communication system of the company.

In brief, it required a complete study of the entire system and all of its holdings and the expenses involved and a correlation of these costs and expenses to future gas production and future revenue. We didn't dare overlook any activity of the company.

530 The men referred to by Mr. Kesinger as having been assigned to assist me, from the engineering department, the drafting department, etc., and the cooperation of the various department heads, have been essential throughout this study. We could not have done the work without their assistance. The work was begun in the early part of 1938. Over a year has elapsed and we are still working on certain phases of the problem. As a matter of fact, some phases of the work have to be completed between now and next week before they will be ready to present to the Examiner. I have worked under tremendous stress in order to meet this particular hearing with the final results of the work.

Our problems have been discussed with outside engineers, namely, Mr. Biddison and Mr. Gill, and their opinions have been sought and their assistance has been given in this procedure. They individually sat down across the desk from me. I described to them the procedure we were following and gave them the information they desired, in order that they might understand what we have done. They have gone over a considerable portion of the information that is in the exhibits and also the preliminary form of some of the exhibits we have here. Some of them have been put in final form since they were here.

Various department heads, Mr. Dickinson, Mr. Strong, and the others named by Mr. Kesinger, have devoted time to this work. These men were instructed that this particular problem was the major problem of the company and they should give preference to it. As far as their time is concerned, I couldn't tell you exactly the total amount of time, the man hours, that have been given to this work because there are so many men involved. It has run so deeply into our field organization and all the other parts of the company I just couldn't tell you how much the total time is. Some of the men have been entirely relieved of their operating duties in order that they would have nothing else to do. Mr. W. H. Davidson, Mr. R. G. Strong and Mr. R. T. Powers were relieved entirely of their responsibility as operators and told to devote their entire time to this problem. That is also true of Mr. Dickinson for substantial lengths of time.

Mr. Kesinger has been the general supervisor of this study and throughout its preparation we have reported to him frequently as to the progress we were making and as to our plans, and have sought his approval of these plans.

In addition to this he has carried on the general management function in relation to revenues and sales. He has given me the figures which I used in my studies as to future volumes of gas sales and the revenues from those sales.

I have undertaken to organize and develop the facts resulting from these studies in such a manner as to present them here in the form of exhibits and testimony, and there will be a number of other witnesses who will testify as to parts of the study, particularly those parts which are in connection with their current operating problems.

Mr. J. G. Dickinson is prepared to testify relating to the capital expenditures of the production department and also relating to the cost of operating and maintaining the production department property.

531 Mr. R. G. Strong will cover the capital expenditures and the cost of operation and maintenance of the field booster stations, of the gathering lines in the field, of the meters and regulators in the field, in fact all the property that exists between the wellhead and the Fritch compressor station. He will also testify relating to the main line system of the two companies.

Mr. R. T. Powers will cover the Texoma Natural Gas Company Fritch compressor station and the gasoline and dehydrating plant at Fritch.

Mr. W. H. Davidson will take up the problems of the compressor stations in the Natural Gas Pipeline Company's property and will testify in regard to capital expenditures and to the cost of operation and maintenance and of replacement.

Mr. W. T. Bulla, the superintendent of the telephone department and the chief pressure dispatcher, will testify in regard to the communication system of the company.

Mr. G. M. Davidson, the chief engineer, has prepared a study of the probable future revenue to be obtained from the sale of the natural gasoline produced at Fritch. He will also testify concerning the future capital expenditures for automobiles and automotive transportation equipment, inasmuch as that property comes under his general supervision.

Mr. S. E. Campbell, secretary of the company, will take up the problem of additional furniture and fixtures and other replacement of the items now in the property account.

The other special phases will be covered by me in another appearance on the witness stand.

The first special subdivision of this work which I am

prepared to present at this time relates to the producing characteristics of Texoma's gas wells. This is a very essential part of our study because it is from this general problem that we obtain our information relating to the future producing ability of the company's wells. In approaching this problem we realized it was necessary, or at least very helpful, to determine the relationship between the rock pressure of the company's wells and the open flow that would exist from time to time at the several rock pressures. By open flow I mean the quantity of gas that will flow from a well if open and allowed to produce without restraint, the total quantity of gas that the well could produce if it produces to the atmosphere and without any restraining influences on it whatsoever. Of course, that is an impractical quantity from our practical application. You never can get that much out. The size of the pipe enters into the calculation.

We had to know the quantity of gas the wells could produce in order that we might know whether or not there was sufficient production on hand to meet the market requirements of Texoma as of any time in the future from year to year. That was an essential piece of information
532 which we had to have in determining the number of wells that would have to be drilled on Texoma's properties in order to keep this open flow at a point where it could meet its market outlets. It was the important element in the well drilling program, and, of course, there are a considerable number of capital expenditures which are contingent upon the well drilling program, such as additional gathering lines, the booster stations, meters and regulators, and all the other pieces of property that are required to get production from the wells into the system.

As to the principle which has been developed in the field of gas engineering to determine the relationship between the open flow and pressure, I point out that several years ago engineers of the United States Bureau of Mines made quite an extensive study of methods of determining the open flow of natural gas wells. The Pitot tube method, which was in use, was not altogether satisfactory. These engineers proceeded to develop a method which we call the back pressure method of testing a natural gas well. The results of their work are given in considerable detail in Bureau of Mines Monograph No. 7. The title of this monograph is "Back Pressure Data on Natural Gas Wells and Their Application to Production Practices."

We have used this back pressure determination, applying it to the wells of Texoma, in our general study of the future production from the various wells. I think I ought to describe briefly what the test is in order that there may be an understanding of the methods we used to apply the principle.

Briefly, the back pressure method of determining the open flow of a well involves, first, shutting in the well for a sufficient period of time to permit the rock pressure to stabilize. That is called the shut-in wellhead pressure. The next step in the procedure is to permit the well to flow at various quantities of gas per twenty-four hours and to record the rock pressure at the wellhead corresponding to these various rates of flow after the rock pressure has stabilized.

This theory and this method as explained in Monograph No. 7 is a reliable method if we keep in mind some of the things that will undoubtedly happen in the sands from time to time. As long as the condition would remain the same as the condition that existed at the time the test was made, future tests made under this principle would give the same results, almost coinciding with the results of the original test that was made. There are a number of factors and a number of things that can happen in the producing strata which we must recognize. I want to mention those because I have not been able to take all those things into consideration in my use of the back pressure method. Some of these things that will happen, we think, relate to the channelling of those strata. They relate to the intrusion of water. They relate to the fact that the producing characteristics of the well would change if additional wells were drilled in the general drainage area of the particular well which we have tested. There is also the salting up of the producing strata by sedimentation. I think that covers the major influences.

533 In regard to the possible effect of increasing the number of wells in a given vicinity so as to effect the drainage area, I mentioned the fact that the drilling of an additional well in the general drainage area of an existing well would have an effect upon the existing well. That is a result that obtains where the number of wells in a given area is substantially increased.

These disturbing factors which operate to cause the actual flowing capacity or potential flow of the wells to vary from that indicated by the back pressure tests will inevi-

tably cause a reduction in the quantity of open flow in relation to the rock pressures. If you apply the back pressure test to a given well and thus get a potential open flow indicated for future pressure levels and any of these interferences which I have enumerated intervene, the actual open flow of the well will turn out to be less than that indicated by the back pressure curve.

I have prepared some drawings showing in graphic form the back pressure curves that have been obtained from Texoma wells.

(At this point counsel for defendants presented a document described as "Back Pressure Test Data on Wells of Texoma Natural Gas Company, Well Groups No. 1 to No. 12, Inclusive." At the direction of the Examiner the document was marked Exhibit 89 for identification.

Counsel for defendants also presented a map entitled "Texoma Natural Gas Company, Map Showing Grouping of Wells as Used in Study of Future Well Conditions." At the direction of the Examiner, this map was marked Exhibit 90 for identification.)

One of the first things I did when we entered this phase of our problem was to check through my files thoroughly to see that I had back pressure tests for all of Texoma's wells. I have back pressure tests for all but one well of Texoma, though it might be that there was a well completed just a short time ago and the back pressure tests have not come in yet.

Page 1 of Exhibit 89 records the data taken at the time of testing Texoma's well named Aebersold 1-G. It is in Gray County, close to the Carson County line, approximately on the west central side of the area numbered 1 on Exhibit 90, in Section 180, Block 3, I&GN, Gray County, Texas.

The upper portion of the page represents the location of the well, which I have just stated, and immediately thereafter we find a statement of the size of the casing in the well, the total depth of the well, and the location of the gas pays. The total depth is indicated at the righthand side of the page. Immediately under the statement of 8¼ inch casing we find a section of the data sheet in which the gravity is stated as being 0.684, and then we find the letter "L" and 2562 feet, this being the average of the gas pay depths. Below the letter "L" we find "GL", which is the product of the specific gravity and the average depth of the gas pay.

The formula below GL is a part of the back pressure
534 interpretation, but it has no particular practical value on our wells and is shown on this chart because at the time the chart was made out we thought it did have some value, but as we proceeded with our tests we found we were not using that particular part of the information shown on the sheet. I refer to that equation which is the square root of GL, divided by K Log, and the figures which are immediately thereunder, ending with Log. e times .0000347 equals .00001507.

I now refer to the portion of the chart which is headed "Shut-in pressure, pounds per square inch." In the line next below the shut-in pressure we find the words "Atmospheric pressure" and opposite them "13.0." That gives the generally accepted atmospheric pressure in the Texas Panhandle. That 13.0 means 13 pounds per square inch.

The next line down reads "Shut-in pressure at the wellhead, gauge, 302.0." This figure is in pounds per square inch and is the record of the pressure gauge at the time the well had been allowed to stabilize its rock pressure. That pressure determination is made with a dead weight gauge in order to get the most accurate determination. The wells will stabilize in varying periods of time. It might be half a day or it might be several days. It just depends on the particular well. All of the features of the producing strata and of the adjacent drilling enter into the period of time required for the stabilization.

The next line down is the shut-in pressure at the wellhead, absolute, and is the sum of the atmospheric pressure and the gauge pressure, namely, 315 pounds per square inch.

The next line is the shut-in pressure at the sand, and the symbol there, "P_t", is one which we will use quite often in the discussion to come. We arrive at the formation pressure, or the shut-in pressure at the sand, as it is called here, by adding to the shut-in pressure at the wellhead, absolute, the weight of the static column of gas in this particular gas well, and we find that weight by reference to certain tables.

Questions by the Examiner.

This "G equals 0.684" enters into the calculation of the weight of the column of gas.

The purpose of that formula I mentioned a moment ago was that if our wells were operating in certain pressure

ranges, we would probably be using that particular correction. It relates to a correction involved in the use of the back pressure data and converts it to future use in interpretation of the data. I don't know whether it has anything to do with intertia or not. If we used it, it would have the tendency of increasing the shut-in pressure at the sand base. That is taken up in Monograph No. 7, and we could tell you more thoroughly about that by going into that particular angle and telling you just how minute that particular correction is. I will look that up and tell you.

Direct Examination Resumed by Mr. Morgan.

535 The next section of this data sheet is called "Observations during the test," and in this portion of the data sheet we find recorded the information obtained when the well was permitted to flow at various quantities for 24 hours and the stabilized rock pressures recorded at these rates of flow. We see recorded in this portion of the page the result of three tests on this particular well. In the first test the pressure at the wellhead, when stabilized, was 284 pounds, gauge, and then absolute 297 pounds.

If we proceed across the line of this particular test we find information relating to the meter data, particularly the coefficient for the particular meter in use and the size of the orifice in use, and then finally a statement of the total quantity of gas flowing per 24 hours, namely, 1,358,000 cubic feet. I use my 24 hour coefficient merely to multiply my meter reading by to get my results.

The stabilized pressure can be taken of a well flowing at a particular rate. It is only the gas that is flowing, not the pressure. After the flow is permitted to continue for a length of time uniformly the pressure as recorded by the dead weight pressure gauge will not change further, as long as that particular rate of flow is continued.

In getting this pressure rating, which I have called the stabilized pressure, at any given rate of flow, the engineer who is making the test on the well watches the rate of flow, the meter registration, and he also watches the pressure being recorded by the dead weight gauge. After he sees that the rate of flow has become constant and after he sees that the dead weight gauge is no longer changing in its pressure recording, he says that he has determined the stabilized well head pressure, and records that pressure as applying only to that particular rate of flow.

Questions by the Examiner.

I hardly know how to describe a dead weight gauge. The pressure record on the spring gauge has to do with the effect of the pressure upon that particular tube in the gauge. On a dead weight gauge we have a piston effect, and we lay all of the weight on top of this piston and it produces a pressure on the fluid in the dead weight gauge, and that in turn makes a registration. That is rather a rough description of what happens. It might not be an accurate description of the particular appliance; but I am thinking from a laboratory standpoint, from a standpoint of testing the gauge.

It is used instead of the Pitot tube because the Pitot tube method of open flow testing has some bad features to it on account of the quantity of gas that is wasted to the air and the hazard of fire and the inability to determine anything about the well other than just its absolute open flow, so we would prefer to use the back pressure test, and then we use a dead weight gauge instead of a spring gauge because in traveling through the country the spring gauges in the company trucks get bounced and jounced and get out of calibration; but a dead weight gauge once calibrated in the laboratory will remain in calibration and will remain accurate in the field.

536 The dead weight gauge is used to take all the pressures when a well is tested, even when it is flowing. I have given a very inaccurate description of the dead weight gauge.

Direct Examination Resumed by Mr. Morgan.

Having completed the first test, which is recorded in Line No. 1 in that part of the sheet I am talking about, the engineer in charge of the tests then causes the well to produce at a different rate of flow and to become stabilized at that different rate, and records the stabilized rock pressure at the second rate of flow, and he proceeds from his second test to the third test. We think that three tests are adequate.

In the first test made on this particular well the rate of flow was 1,358,000 cubic feet per 24 hours, and the corresponding stabilized pressure was 284 pounds, gauge. On the second test the quantity of flow was 2,037,000 cubic feet per 24 hours, and the corresponding wellhead gauge pressure was 274.6 pounds. The third test used a flow of 2,827,-

000 cubic feet and recorded a wellhead pressure of 264.2 pounds gauge.

In this particular instance the man who made the tests was W. H. Tompkins. We have located at Fritch, Texas, two gas engineers whose principal function is to make the various tests on the wells. They are constantly testing wells for one reason or another. I would say that these men have been engaged in this kind of work three or four years.

Questions by the Examiner.

The time interval between these series of tests would depend upon the individual characteristics of the well. It will vary. When this well was producing at the indicated quantity per 24 hours in the second test, the well was unable to produce a pressure registration at the wellhead in excess of 274.6 pounds. There must be a pressure differential between the formation and the well bore in order that the gas flow. We probably used a different size of orifice because that particular meter would not carry the quantity in the second test with the size of orifice that was used in the first test. The degree of accuracy of measurement entered into the use of the larger sized orifices as they continued through the tests.

As to how long it was after we completed our first test before we started the second test, it is shown under remarks on this page that the flow was taken on the pipeline meter over night and then changed to flow prover, making a 24 hour stabilization on each point. The amount of stabilization time would be different for each well. It might be hours and it might be, as indicated here, a half a day or longer. The only thing we can do is wait for it to stabilize. We have no way to make it stabilize. The indication from the remarks is that it was 24 hours between test No. 1 and test No. 2 and 24 hours between test No. 2 and test No. 3 on this particular well.

Direct Examination Resumed by Mr. Morgan.

This section of the sheet is called "Calculation of back pressures at the sand." We find the data recorded for each of the three tests.

As to the first test, we find that the wellhead gauge pressure has been converted to pressure at the face of the
537 sand, at the bottom of the well bore, by the application of the 13 pounds per square inch atmospheric pressure

and by the further application of the weight of the column of gas under the flowing conditions that existed at the time the test record was made. The result is to obtain, for the first test, an absolute pressure at the face of the sand at the bottom of the well of 315.3 pounds per square inch absolute, while the well was flowing 1,358,000 cubic feet each 24 hours.

The back pressure recorded at the time of the second test is similarly handled in order to arrive at the absolute formation pressure at the face of the sand at the time the quantity of gas flowing in the second test was flowing, and, similarly, we determine at that third test the absolute back pressure at the face of the sand at the bottom of the well.

Questions by the Examiner.

The column heading on the division I have just discussed, the calculation of back pressures at the sand, is meant to indicate that in the following section of the sheet there are recorded the steps involved in getting from the well head gauge pressure to the be absolute pressure at the face of the producing sand.

The data sheet as made out is not used in the record of the information. It is another instance where the original concept of the sheet was found not to be useful in the actual work of the tests. In fact, we have a different form in use at this time, and I simply chose this particular well because it was tested about the time we commenced the study of the economics of the property. The symbol P_2^2 is not used on the data sheet. It is shown there because the form was incorrectly made and we just continued to use it without getting new copies printed. It is something that was on the form they used and is not something they used themselves in making the tests.

Direct Examination Resumed by Mr. Morgan.

The next portion of the page is called "Calculation of the fundamental relation," and this is a particularly important phase of the test because it is this fundamental relation that we are actually seeking to determine. This fundamental relation is the name given to the relationship between the open flow quantity of the well and its corresponding coincident rock pressure.

In the first column of this portion of the chart we find

recorded the several absolute pressures at the face of the sand at the time the following tests were made and these absolute pressures have been squared and the figures given are in the thousands. In other words, the square of 315.3 pounds absolute is 99,400, approximately, and it is recorded on the data sheet as 99.4 for convenience. That particular F that has been squared is the symbol P_f that I said would be used frequently when I was discussing the group part of the exhibit.

Immediately above the figure 99.4 we find the symbol P_t^2, and to the right of the symbol we find a figure 112.0, and that figure is the shut-in pressure at the face of the sand recorded above as 334.6 squared and written down here in terms of thousands. Below the figure 99.4 we find the other flowing sand face pressures squared and recorded.

538 To the right of this column we find the difference between the shut-in pressure in the formation squared and the sand face pressure squared at the time the several flowing tests were recorded. When I say pressures squared, I mean absolute pressures.

In the next column to the right we find the statement of the quantities per 24 hours at a pressure base of 16.4 pounds per square inch that flowed at the time the several rock pressure test records were made, excepting, of course, the shut-in rock pressure tests.

The remarks in this section are meant to be field notes of the gas engineer making the test and are down there for his information and interpretation.

The pressure is found in the section called "Calculation of back pressures at the sand," and it is the righthand figure of 315.3.

On the bottom of this page we find on the lefthand side of the bottom line "Absolute open flow equals 13.7," and that indicates that the open flow of the well at the time it was tested was 13,700,000 cubic feet per 24 hours at 16.4 pounds pressure base. If the well produces without any restriction whatever, that is for the open flow quantity that is recorded at this point. It is not possible for a well to produce without restriction if it extends a distance of two or three thousand feet from the bottom up to the surface, surrounded by an iron casing; but in our determination of the absolute open flow we disregard the conditions that may exist above the sand face and simply take the absolute formation pressure that was determined under

shut-in conditions. The friction of the casing itself is disregarded in the method determining the absolute open flow. You disregard everything; it is an ideal term. The absolute open flow is not accomplished, in fact, in the producing of a gas well, ever.

We next find the date of the chart and the name of the engineer who made the test.

Page No. 2 of Exhibit 89 is the chart of the data obtained in the back pressure test of the Aebersold 1-G and has been prepared as a sample to illustrate some of the principles involved in the back pressure work. It is just a graphic picture of the same data that is reflected on page 1.

I have been asked to explain that chart or graph, beginning first with the type of drafting paper that was used, and then explaining the legends at the lefthand side and at the bottom and up in the upper lefthand corner and also in the lower righthand corner.

This type of cross-sectioned paper is constructed on the basis of the logarithmic scale, and we commonly refer to it as log-log paper because both the vertical and the horizontal divisions are divided by the logarithmic scale. This type of paper is probably used by the Bureau of Mines engineers because of the fact that the mathematical relationship of the data they were obtaining would, when placed on this type of paper, produce a straight line when the points were connected; and that is a very convenient thing to have. This convenience results from the fact that the data can be projected to either side of the recorded points with the most accuracy as compared with curvilineal lines.

539

The scale on the lefthand side, in other words, the vertical scale, is what we commonly term the pressure factor, and it is the difference between the shut in pressure in the formation squared and the pressure at the sand face squared at the time a specific quantity of production was being obtained.

I have been asked to explain what I mean by formation pressure and pressure at the sand face. One of the first steps in the testing of the well is to determine the shut-in pressure at the wellhead and then we convert that to what we call formation pressure—that is, the pressure that is really in the formations producing the sand—by taking the wellhead shut-in pressure and adding thereto the

atmospheric pressure and the weight of the column of gas. That is the pressure back in the formation from the well-head, and that is the meaning I intend to convey when I say "formation pressure."

When I say "sand face pressure" I am attempting to indicate the pressure existing at the face of the producing sand in the well bore at the time the flow tests were taken. That is the surface of the cylindrical bottom portion of the well. It is the inside of the doughnut down there in the well.

The bottom scale is expressed in millions of cubic feet flowing per 24 hours. In order to draw the heavy diagonal black line shown on this chart, we go back to the data sheet in the part called "Calculation of the Fundamental Relation," and in there we find that test one had a pressure factor of 12.6 thousands. We take that quantity of 12.6 thousands and proceed to page 2 of Exhibit 89 and find that value on the vertical scale. We also note on page 1 of the exhibit that the quantity of production at the time of this test was 1,358,000 cubic feet per 24 hours. We turn to page 2 of the exhibit and find this value on the bottom scale and cause our two points to converge at the point on the black line indicated as Ps equals 315.3.

We have thus charted one of the test data fundamental relationships, and we proceed similarly to chart the other fundamental relationships determined in the test.

After we found those three points we joined them with the use of a straight edge, and if the three points are on the line of the straight edge we know that our test data has been taken with accuracy. If there should be some variation, or, in other words, if some point did not fall on the straight line, we would know that we should go back and retest that well. Something had happened. It had not been stabilized or some other condition existed.

This sample chart also indicates the method of determining the absolute open flow of the well, and we find that story told by the broken line horizontal in the upper left portion of the page, and by the broken line 540 vertical in the middle of the page.

The horizontal line in the upper portion of the page records the fact that the shut-in formation pressure was 334.6 absolute, and it also records the atmospheric pressure, and that is the only pressure which we assume to be at the face of the sand for the purposes of determining the absolute open flow of the well.

When we square those two values, we find 111.957 minus 169 equals 111,788, and we also find a broken line immediately under the figures, and it proceeds from the left hand scale to the right to the heavy solid line, and we then read downward from that intersection to the horizontal scale, and then the horizontal scale tells us that the absolute open flow of this well at the time it was tested was 13,700,000 cubic feet per 24 hours. We could have obtained this answer by calculation, but we put it on this chart because we thought it would be a more clear explanation of this procedure.

What I have done is to follow Monograph No. 7 and construct my own pressure graphs for each of my investigations.

I have a similar data sheet and a similar chart for each of Texoma's wells, except for perhaps a recently drilled well for which the test data has not come in, and excepting one other well of Texoma. I do not have the data on that well because it is a bradenhead well and is not in a position to be tested. The Bradenhead is the fitting that is put at the head of the well if the well is producing both oil and gas. The gas is produced from an upper formation around the oil producing tube, coming out inside the main casing of the well but outside the tube or casing through which the oil flows, and we cannot make this kind of a test on that type of well with the fitting in place.

These back pressure tests and back pressure charts enable us to determine the fundamental relationship between the open flow of a well and the rock pressure at the time the open flow existed. Therefore, we can take this test data and determine what will be the open flow in the future of this particular well, when some other rock pressure will exist; in other words, when the rock pressure has declined. When the rock pressure declines from that registered here, which was 302 pounds at the wellhead, to 250 pounds, the conditions remaining the same, this chart would indicate what the open flow would be at a pressure of 250 pounds, or any other pressure in the future.

I have been asked to explain how I have utilized this back pressure test principle, which demonstrates the relation at present and in the future between open flow and pressure, in predicting the future flowing capacity of

Texoma's wells. Of course, we were able to make a back pressure record for each one of Texoma's wells and thereby we could foresee the future conditions in these existing wells, but it was also necessary that we have some interpretation or some means of finding what would be the open flow conditions in other wells which Texoma could be expected to drill in the future, and by the use of these actual well tests we have gone through a procedure which enables us to reflect the probable open flow conditions in the future in all the wells that Texoma
541 may have from time to time.

Our first thought was that we could take the individual well data and determine therefrom an average which would relate to all of the wells of Texoma, but when we placed the individual lines of the various wells—the back pressure lines—on a chart, we found that the average line of all these individual well lines was considerably divergent from the general pattern of the sheet. It seemed to us, therefore, that it would not be sound to use an average of all the wells, and that we should do some further work on this particular point.

We were also aware of the fact that any rock pressure forecast relating to the average of all wells would have a tendency to dampen out the pressure conditions throughout Texoma's area and would effect a result in our arriving at a booster station requirement that would be much too low. We felt that we should find some means which would permit us to more nearly reflect the local characteristics of Texoma's producing property or property to be produced.

With that thought in mind we next made a chart of each county, and on the particular county sheet we drew the back pressure lines for each of the wells in that county. That was a better interpretation. We saw that our pattern was becoming more nearly a useful pattern. In other words, the average line to the county was more nearly a reflection of the county situation.

Questions by the Examiner.

The pattern difficulty was that when we charted each one of Texoma's wells on a single sheet and then placed thereon a back pressure line representing the average of all the wells, we found that there was too much variation

of many of the individual lines as compared to this average line.

I did not mean to indicate that, theoretically, back pressure graphs on any two wells should resemble one another. There are individual characteristics. There will be a degree of resemblance but not an exact resemblance. In taking so many wells they spread throughout the chart in such a manner that some of the lines were so far away from the average line for all of the wells that we felt that we did not have a useful interpretation at that point. I would not say that at any pressure factor we noted a deviation from our result that was not what we had anticipated. It was the general picture that we saw presented by this particular chart plus our realization that we were recording the rock pressure as an average throughout the field and we must avoid doing that because of the local rock pressure conditions.

The chart of well group No. 6 may be used for an explanation of what I mean by the composite or average back pressure line of the four wells whose back pressures are recorded on this chart. The four back pressure lines recorded on this chart are shown in solid black line 542 and the average of the four wells is shown by the broken line which you see running diagonally generally midway between the line farthest to the left and the line farthest to the right.

In preparing that average line we assume two different values for the pressure factor. We assume the value of ninety thousand for the pressure factor. It is not shown on the chart. We assumed that value of ninety thousand for the pressure factor and then recorded on our work sheets the open flow quantities from each of the several well lines at that pressure factor. We also took another pressure factor, namely, fifteen thousand, and recorded the open flow quantities relating to that particular pressure factor, and with these two open flow quantities determined, we calculated the position of this back pressure line representing the average. That gives the position and the direction of the line. In other words, we determined two points on the broken line and joined them.

As to what that average line showed with respect to the others that led us to a dissatisfied state of mind, I point out that if you were to put 143 lines on this particular sheet and determine an average line in the method I have indi-

cated, you would see that these 143 lines swung in many different positions in relation to the average line.

The purpose of solving for this average or composite back pressure line in the different groups is to obtain a present situation as to the average composite lines, back pressure lines, of wells which have not yet been drilled and, therefore, cannot be tested for the purpose of this hearing; and in order to get information which is of value it is impossible to take as a whole the conditions obtaining in the different portions of the field where the producing conditions, the pressure, the open flow, and the other elements that enter into these tests are so variable under the physical conditions and under the operating conditions that have obtained and do obtain down there, that such an average composite line would not be useful in determining what the behavior or what the relation between future open flow and the pressures of the wells yet to be drilled will be.

Direct Examination Resumed by Mr. Morgan.

There is a further item of interest on page 2 of Exhibit 89. At the bottom of the title of the sheet we find N equals tangent of "A" equals x/y, and so forth. In our work on back pressure tests and their application to production problems we also determine this so-called "N" value or the slope of the back pressure line in relationship to the vertical axis of the chart. That gives us a quick indication as between various wells of the rate at which we can expect the open flow to decline in comparison to a decline in rock pressure. In other words, most gas wells will not decline as much as 10% in rock pressure when they decline as much as 10% in open flow. Of course, I am referring to Texas Panhandle wells. The slope of this line expressed in numerical value tells us what we may expect as to the percentage decline of rock pressure and the percentage decline of open flow during the same time.

543 *Questions by the Examiner.*

As to whether that result gives us a figure we can use in calculations and we do not have to read our graph, I will say that we do use that value in calculations, but the more important thing which that value shows to us may be illustrated by taking the "N" value of two different wells

and seeing what these "N" values are. If the "N" value of a well is .6, we know that when the rock pressure declines 10% the open flow will have declined only a little more than 10%; but if the "N" value of the other well is in the nature of one, we know that the second well, when it has declined 10% in rock pressure, will have declined considerably more than 10% in open flow during the same period of time. In other words, the slope of the line off of vertical indicates an increasing tendency to decline in open flow at a more rapid rate than the decline in pressure. It means we would have to do additional drilling at an earlier date in order to take care of the decline in open flow.

We were led to grouping these wells because the back pressure tests which we had on hand could be used in forecasting those particular wells, but we had to have some means of forecasting the wells which were yet to be drilled on the property of Texoma, so we sought to obtain an average that we could use in forecasting.

(At this point counsel for defendants made the following statement:

I would like to make a preliminary statement here of what I am expecting to prove by this witness in connection with these back pressure curves in order to make it, I hope, somewhat easier to follow.

The purpose of this proof is to show that there is a definite relation in a given well, so long as the formation conditions remain the same, between the pressure obtaining in that well and its capacity to produce, or its open flow, and that by means of a test this relationship can be determined so that, looking to the future, this back pressure test and the chart which is drawn from the result of that test will indicate what the open flow or capacity to produce will be in the future, whatever that future pressure may happen to be.

Now, we propose to show by other proof which we will reach a little later—this matter is so complicated that we can't bring it along together—that we think we have a way of ascertaining the course of these pressures, and having obtained the pressures, then, by the application of these back pressure curves we hope to demonstrate what the capacity of the wells to produce will be in the future, reflecting, of course, upon the need for wells in order to meet the requirements of these pipe lines.

The back pressure curves themselves are all that we need

in predicting the future productivity of that particular well, or of these particular wells on which we have back pressures, at any assumed or given pressure in the future; but we can't get the full picture because we are drilling wells all the time. We know now it is going to be necessary to drill a great many more wells, and in order to see
544 how many more wells we are going to have to drill we must find out the behavior of the potential capacity to produce of the wells that are in existence now and also those that are yet to be drilled, and it is for the purpose of ascertaining the relationship of the wells to be drilled in the future that it becomes necessary to deal with what the witness has termed here a composite of the back pressure curves in particular areas.

The evidence will show that the reason we could not take these 140 some odd back pressure curves, and take the composite of all of them in arriving at the probable relationship between the potential open flow or capacity to produce and the pressure of wells yet to be drilled, is that there must be, in order to make such a prediction, a similarity of certain conditions, namely, there must be comparative uniform pressure in the area where the wells have been drilled and in the area where wells are yet to be drilled; there must be similar formation conditions; there must be similar drainage conditions, and by drainage in this connection I mean surrounding drainage; and certain other factors which the evidence already shows are highly variable in the different portions of this field.

And for that reason it has occurred to these engineers that by breaking this area in which Texoma has properties into smaller local areas where the pressures are about the same, where the formation conditions are about the same, where they are subjected to the same outside drainage considerations, and by taking the wells located in those local areas, and taking the composite of the back pressure curves of those wells, they can reasonably predict a composite of the back pressure curves of the wells yet to be drilled, as well as of those which have already been drilled in those areas; and then taking those results and applying them to the pressure which will obtain in the future, they predict, and they think with reasonable certainty, what the potential producing capacity of those wells will be from time to time on through the future as those pressures go down to the levels where the studies are discontinued.)

Direct Examination Resumed by Mr. Morgan.

I have stated why, in predicting the future behavior of wells to be drilled by Texoma on its reserves, I could not use a composite of the back pressure curves of all the wells on one chart and thus hope to arrive at the indicated average back pressure curves of all wells, including those to be drilled in the future. I made the same statement with reference to studies that I had made up by counties. Texoma's wells are in four counties, namely, Gray County, Carson County, Hutchinson County, and Moore County, Texas.

As to the conditions which enter into the question of the reliability of the ascertained composite of the back pressure curves of existing wells as pointing to the relationship between capacity to product or open flow and pressure of wells yet to be drilled, if the original test data is obtained under the proper conditions, then future tests made under the same conditions will give a back pressure line which
545 is in coincidence with the line originally obtained.

However, here are a number of things that happen in the producing strata that will tend to cause a deviation from the line originally obtained in the first test.

For example, if there is a water intrusion in the sand we may expect that a future test will show a different relationship between open flow and rock pressure. If there is a channeling in the sand or sedimentation or salting or a reduction in the area of sand face exposed in the well bore, all of these things will cause a change in the relationship between rock pressure and open flow.

I have been asked to state the best means, prior to the drilling of wells, of arriving at the relationship between the open flow and the pressure of those wells yet to be drilled. Inasmuch as we cannot now determine what the back pressure test data would be of a well not now drilled, the best way for us to get an indication of what the future wells will be on the average in regard to the relationship between rock pressure and open flow is to arrive at an average of the existing wells and to use it in our future projection for all wells.

In determining whether or not you can reliably predict, or predict with reasonable certainty, the average back pressure curves of wells to be drilled in the future, it is desirable as to any given area to have that area cover similar conditions as to the producing strata and the rock pressure, the open flow productivity, and other elements of the

producing characteristics of the wells in the area. We have to consider also the inside and the outside drainage, so to speak. We have to consider the entire effect of the production throughout the field. Speaking of Texoma's holdings, we do not have such uniformity of conditions throughout the area in which Texoma's wells have been drilled and will be drilled in the future.

I think that one method of illustration would be to cite the fact that pressures in the Gray-Carson County border line are lower than the pressures over in Texoma's Coon ranch in Moore County, for example. The eastern side of the field, the border line between Carson and Gray Counties, has suffered a considerably larger amount of drainage through a considerably longer period of time than Texoma's holdings over in Moore County, in the Coon area, or the Thompson area, or other places where Texoma has leases.

Comparing the area colored in pink and numbered 1 on Exhibit 90 and the area colored brown up in Moore County and numbered 10, the drainage would be greater and the rock pressures lower in the pink area than would be the case in the Moore County area which is colored brown.

If back pressure tests were made of the wells in area No. 1 and back pressure tests were made of the wells in area No. 10, and a composite is made of the back pressure curves of the wells in those two areas, that would not be a reliable indication of the relationship between potentials and pressures of wells drilled in area No. 10. Obviously, the lower rock pressure existing in Group 1 is going to show a lower open flow existing in that area, using only rock
546 pressure as a guide, and therefore the composite of Group 1 and Group 10 would not, in my estimation, be the proper average to determine in the problem that we are studying.

That is what I meant when I said we could not take all of the wells of Texoma and construct their back pressure curves on the same chart and arrive at a composite that would be the most accurate in predicting the relationship between potentials and pressures in the wells to be drilled by Texoma, scattered over the whole area of its holdings. I meant to indicate that the composite of the whole would not be nearly as accurate as if we divided the whole into constituent parts and determined a composite of each constituent part, and applied the composite to that constituent part only.

We abandoned the idea of making four groups by coun-

ties because, using Carson County as an example, we know that the rock pressure and drainage conditions on the eastern side of Carson County are different from the rock pressure and drainage conditions on the northwestern portion of Carson County.

We finally decided that we would break the county areas into smaller than county areas; that we would use a number of areas in a county; and that we would strive to have the areas reflect a reasonable degree of comparable production conditions.

Pressure was the principal determining factor which we took into account in dividing these properties into these areas. Our knowledge of the drainage in the area was another factor, because we felt that where wells had had considerable drainage they would be the ones which should be included in a group, rather than including some wells that had had a lot of drainage and some wells that had had very little drainage.

We finally settled upon thirteen areas within which the Texoma properties would be found. I have delineated those areas on a map so that they can be pointed out, and that map is Exhibit 90.

I used the word "group" in describing an area of land because I divided the Texoma wells and the Texoma acreage into groups and came into the habit of calling them by specific group numbers. I named area No. 1, Group 1, because I had a group of wells located in that area which I call Group 1 of Texoma's wells, and that is true of each of the other areas. The order of numbering has no particular significance.

In Group 1 Texoma has a number of wells and a quantity of leaseholds, but it does not own all of the leases nor all of the wells that are in that area. This is one of the low pressure areas on Texoma's property. I made that particular grouping because it was my judgment that the production conditions in that area were sufficiently comparable from well to well that it was reasonable to group these particular wells into a group.

The next group is numbered 2, and is the purple colored
area in the south portion of the northeast quarter of
547 Carson County. It extends over a considerable area.

Within that area Texoma has a number of wells and leases, but does not own all of the leases and wells in that area. It is a fairly good rock pressure area. It is neither

suffering from the most intense drainage nor from the least drainage.

The next group is Group 3-A and is the orange colored area located in the upper half of the northeast quarter of Carson County. Here again we find that Texoma owns some of the wells and some of the leases in the area, but not all of the wells and the leases. This is an area which has suffered a considerable amount of drainage, particularly from the production of oil to the northeast.

Group 3-B area, lying between Group 3-A and Group 2, is an intermediate area as to rock pressure and drainage, as is evidenced by its location on the map.

At one time in our study we did not have 3-A and 3-B, but had simply 3. When we considered Group 3 as we had it constituted, we came to the conclusion that our information would be more useful and our prediction more accurate if we split the area into two areas, 3-A and 3-B. The area designated 3-A is very much closer to those low pressure oil field areas than 3-B, and consequently has a lower pressure than 3-B, and we thought we would get more uniform pressure conditions in 3-A and 3-B separately, and also more uniform drainage influences, taking those areas separately, than if we put them together as we started out to do. The work had progressed so far that I did not want to go through and change all of the group number designations.

The next group in order is Group No. 4, and is the brown colored area, roughly in the southeast quarter of the northeast quarter of Carson County. This particular area contains a considerable portion as to area of the very large Burnett ranch. This particular ranch has not been heavily drilled and, as a consequence, the rock pressure conditions in this area are higher than the rock pressure conditions in areas which have been more intensively drilled and which are closer to the points from which the great quantity of gas production has been obtained in the past. In Group 4 Texoma has a number of wells and leases, but here again does not own all of the leases and wells in the area.

Group 5 lies on the north side of Group 4 and is in the northeast quarter of the northwest quarter of Carson County. It contains quite a few Texoma wells and a considerable quantity of Texoma acreage, but Texoma does not own all of the wells and acreage in the area. This area No. 5 is another area which has had considerable

drainage because of heavy gas production in this particular case to the north of the group, and I think the heavy production to the northeastward has also had its effect on Group 5.

In Group 6, which is located in the southwest quarter of Hutchinson County, we have a relatively small area, and in here Texoma owns a number of wells and some leaseholds but of course not all of the property in the area. This
548 group is quite close to Fritch, the compressor station of the pipeline company. It has had considerable drainage from the heavy production in the southwestern portion of Hutchinson County.

Group No. 7, colored in blue and located approximately in the east central portion of the southeast quarter of Moore County, contains a considerable quantity of Texoma creage and a number of its wells. In this group we find that the rock pressures are getting higher than the rock pressures in the previous groups discussed, for one reason because the group is more removed from the effects of drainage. I mean the rock pressures in Group 7 are higher than the rock pressures in the previously stated groups, and not that they are increasing. Texoma does not own all the property in this area.

Group No. 8, the orange colored area in the center of the east half of Moore County, contains a number of Texoma wells and a quantity of its leaseholds, although Texoma does not own all of the gas producing property in that area. This group has not had as much drainage as groups to the east, but it is now going to suffer some of the drainage that is being created by this heavy gasoline plant—carbon black plant production resulting from the intense amount of drilling that occurred in the northern portion of Moore County during the last few years.

Similarly, Group No. 12, the green area about the center of Moore County, is going to suffer from the drainage of this increased concentration of gasoline plant and carbon black plant production. In Group 12 Texoma has quite a bit of acreage and a number of wells, but does not own all of the gas producing property.

Coming now to Group No. 9, which is also approximately in the center of Moore County, we find ourselves in a rather intermediate position on the rock pressure conditions, in that the drainage in this area is more of the local drainage from the surrounding area rather than the drainage to that heavily concentrated production in the oil areas

in the northern part of Moore County. Texoma has quite a bit of acreage in this area and a number of wells, but it does not own all of the property.

Group No. 11, colored yellow, again approximately in the center of Moore County, is almost completely Texoma acreage and Texoma wells. It is the area we recently referred to as the Coon ranch and is a high pressure area in that it has not suffered much drainage in the past. We do note that there is an increasing tendency for drainage to affect this group and it is coming primarily from the heavy gasoline plant and carbon black plant production in the northern part of Moore County.

Group No. 10, located in the southwest quarter of Moore County, contains a number of Texoma wells and quite a few of its leaseholds. It is removed from the heavy drainage of the large gas producing area, and, as a consequence, has not had its pressure so materially affected. Its pressure decline is more a matter of local drainage than of gen-
549 eral drainage in the field.

I have prepared a chart for each of those groups showing the back pressure curves of Texoma's wells. Those charts are found in Exhibit 89 and start with the third page of the exhibit and continue for thirteen pages.

There are 12 Texoma wells in Group No. 1, all of which are charted on the composite chart of Group 1, page 3 of Exhibit 89. While that group contains the Bradenhead well which has been mentioned previously. It has no test, but each well in the group was assigned a number for identification purposes. There are only 12 back pressure curves reflected, and those 12 are all of the wells owned by Texoma in that area, except this Bradenhead well, on which there is no back pressure test.

We have made tabulations of the wells in these various groups and have included the tabulations in the back part of Exhibit 89, the pages of which are numbered 1 to 13, inclusive. Those pages list the Texoma wells that are in the various well groups and are charted on the back pressure charts of the various groups, except, of course, the Bradenhead well. They show the name of the well, the number of the well, and the description of the land on which the well is situated so that the well can be identified on the map.

Turning to page 3 of the exhibit and to the expressions on the left-hand margin such as "P_f^2-P_s^2) thousands," the letters contained within the parentheses are commonly referred to as the pressure factor. P_f is the formation pres-

sure determined under the shut-in conditions at the time the well was tested or a well would be tested, and the characters squared indicate in mathematics that the number is multiplied by itself. The character P_s refers to the pressure that existed immediately at the sand face in the well bore at the time a test was made under flowing conditions, and here again the square of the number indicates that it was multiplied by itself.

In plotting these curves we do not use the pressure test figures but convert them to the pressure factor that is indicated in the lefthand margin of this chart, and that pressure factor is the same thing I explained in connection with this sample back pressure curve. It is the same kind of charting paper. The figures along the bottom margin of the chart have the same significance as in the sample chart I have been talking about on page 2 of this exhibit. In this page 3 of the exhibit we are dealing with exactly the same things we have described in relation to the Aebersold well.

Each solid black line on page 3 is the back pressure line of a particular well. The numbers underneath key the line into the tabulation in the appendix of the exhibit, where we find, for example, in Group 1 that well No. 1 is the Osborne, or, to reverse it, the Osborne well is No. 1. You can take the number 1 or the number 2 or any other one of those numbers and turn over to this page 1 of what we have called the appendix, and see which one of those wells is rep-
550 resented in the back pressure curve above that number.

These back pressure curves were constructed from these test data sheets or from the back pressure charts which had been made from these data sheets.

There is a broken line running up through the other lines, underneath which is an arrow pointing up from the letters AVG. The letters AVG are an abbreviation for "average," and mean to indicate that this broken line seen on the chart is a line which represents the average of all the wells charted, or, as we more commonly speak of it, the composite back pressure line for this particular group of wells. We arrive at that composite line or curve from the back pressure curves of which it is the average or composite by finding two points which we know will fall on the composite line and then by drawing a straight line connecting these two points and projecting it to either side of the points.

The method that we use in determining these two points is to assume two values of the pressure factor. We take the first value we assume, which in this case is 90,000, or 9

on the scale of the chart, and by 9 I mean that particular 9 which lies between the figure "10" and "100" on the vertical scale of the chart, and then read the open flow of each well at that 90,000 point on the back pressure line of the well. When we had obtained the open flow of each well we added the open flows together and obtained the arithmetic average, and then with that arithmetic average and using the bottom scale of the chart located that particular arithmetic average as so much open flow quantity and so much pressure factor. That gave us one point.

We determined our next point in a similar manner, but by the assumption of a pressure factor of 15,000, and that 15,000 point would be located on this chart between the No. 10 on the vertical scale and the No. 2 next above it, and, of course, is the fifth division counting upward from the No. 10. Here again we got the open flow quantity from each of the back pressure lines, averaged them arithmetically, charted the arithmetic average in conjunction with the assumed pressure factor, and thus located the second point on our composite line. Then by taking the straight edge we joined these two points and extended such line to either side of the data points. The result was the composite back pressure line for Texoma's wells in this particular group.

We selected 90,000 and 15,000 as the control points because ordinarily it is advisable to make the back pressure tests at quantities of production which cause the pressure factor to fall within the center range of this chart. I say center range just as a matter of illustration. I really mean that they should fall within a fairly narrow range of pressure factors, because in this type of paper the accuracy of plotting decreases as you progress into the higher values of the scale. Therefore, we selected 90,000 and 15,000 as our pressure factors for the determination of the composite average, because they do fall within the approximate range of the test data, and gave us the most accurate composite line. The basic data for any one well are taken within the ranges that I have indicated.

551 This composite line which we have determined for that particular group indicates to me the future relationship between the rock pressure and the open flow on the average of the wells in that group, not only as to the present wells in the group, but also the future wells that Texoma may drill in that area. We anticipate drilling one more well in that group, and it is my view that the drilling of that additional well is not going to change the composite

back pressure curve of the 13 wells that we will then have in the area. If there were more wells to be drilled within that group, it is my opinion that, while they would not fall exactly upon the composite line for the group, they would fall in such positions to either side of it that on the average they too would come back to the same relationship of rock pressure and open flow that we have depicted in the average line of the existing wells.

Questions by the Examiner.

(Counsel stated that there was no uniformity as to the size of the area, but that it was just the area where the formation conditions, such as pressure and drainage and other influences, are the same which determined the size; that there was no particular quantity of acreage in any of those groups belonging to Texoma; that the groupings were so made as to encompass all the properties that Texoma was producing into its pipeline system and on which it intended to produce hereafter; that the reason other land was included was because it just happened that other people owned leases there, but of course the company had not had access to their wells to make tests on and had not made any tests on wells belonging to others.)

The slight deviation which might appear between a graph in Group 1 and the position shown in the sample curve would be more a matter of the draftsman in drawing the chart. The representation shown in Group 1 is more apt to be the correct one than the other; but we work with calculations a lot in order to avoid the very thing just pointed out. I would use a chart for a quick answer, but if I wanted to be sure my quick answer was right, I would enter into a calculation.

Direct Examination Resumed by Mr. Morgan.

By and large my deductions from these charts are based on accurate calculations and are not taken from the chart itself. This chart No. 1 was intended only as an illustration or demonstration of what is meant by back pressure curves.

This zone or area which I have termed Group 1 could have been broken up into two or three or half a dozen smaller areas. One of the things that entered into our de-

termination of the particular areas adopted was an effort to get enough wells in the group to give a reasonable composite average. In that particular area the differences between the wells were not so extreme that we felt there was any need to subdivide them further, and then, too, the
552 more groups we have, the more work we must do in other phases of our study, and the amount of clerical computations involved in this work is very large. It is desirable to get some outside limits on a chart in order that the average may fall within it, and also in order that the future wells might be conceived as falling within the outside limits of the charted data.

Questions by the Examiner.

We felt we had a sufficient number of groups to give us a reasonably accurate forecast. As to well grouping, if we had constructed our groups so as to have more of the right-hand lines in one group and one of the left-hand lines in another, we would have gotten a different result, but the combination of the two results would again come back comparable to the one result that we got.

I do not recall the areas of all the different groups that we studied. We had at one time about 24 groups, I think. We gave further study to it, and came to the conclusion that the 24 groups were not adding anything more to our general solution of the problem than a lesser number of groups, except doubling the work, and furthermore, there is also that element of the greater number of groups having a fewer number of wells and not giving us the spread from left to right on the chart within which the composite line would fall.

This is probably the third set of these back pressure graphs that I have made. The back pressure tests of the individual wells were not made specifically for this proceeding. It is a matter of routine with us to test our wells. We actually use these back pressure tests to plan our program, and the production men use them in their work. We are using this special assembly in our present and future plans, and this is the order and arrangement that we use in determining the future economics of the companies for the purposes of these proceedings here. We have not used any similar order and arrangement for forecasting a plan on which we are now operating.

(Counsel for defendants here stated that this grouping

has been prepared especially for the purposes of this case; that the companies do not need the grouping for the purposes for which they use this information in a routine way in connection with the studying of the history of the wells, and that it is not until now that they have ever been able to get through a study which would give them the answer as to the number of wells they are going to have to drill; that they had been working with it, but they have never known as much as they know now about what those future drilling requirements are going to be, because of the very
553 involved study; that these back pressure graphs are indicative of the total number of wells that they are going to have to have in order to obtain the open flow that will enable them to keep their pipeline loaded as long as there is gas available; that they have been drilling additional wells knowing that additional wells had to be drilled; that the lease obligations have had much to do with the drilling in the past, and it is only at this time that they have arrived at what they think is the answer as to the total number of wells they will have to have.)

Direct Examination Resumed by Mr. Morgan.

I have stated that I prepared a similar chart showing the actual back pressures of the wells in each of the groups delineated on Exhibit 90, and that I have ascertained the composite of those back pressure curves. I am now asked to state what that composite back pressure curve on each of the charts representing the other areas or groups pictured on Exhibit 90 indicates to me as to the relationship between the open flow and pressure of wells to be drilled in these respective groups.

We have made 13 of these group charts. Each one of these charts indicates to me as to that particular group what the relationship would be in the future between the rock pressure and the open flow of Texoma's wells in the group area, both the present wells and the future wells. Necessarily, the future wells individually will have back pressure lines which will not always be exactly on this composite line for the group. In fact, there may not be any of these individual wells fall exactly on that composite line, but they will fall to either side of the composite line, and, on the whole, the average for all wells, old and new, will conform to the composite line which we show on the chart for the group.

Such variation as there may be would not cause any particular change in the answers or conclusions that come from this work.

Page 4 of Exhibit 89 is the back pressure chart for the Texoma wells in Group No. 2. There are 24 wells charted on page 4, and that chart is prepared from the same kind of data and on the same kind of charting paper as the chart reflecting back pressure curves of wells in Group No. 1. The procedures were similar. We determined the composite back pressure line for Group 2 and it is the broken line shown on page 4 of the exhibit. The ultimate development in this group will be a total of 44 wells. That will mean an addition of 20 wells after the time this chart was made, or an additional 21 wells after January 1, 1939.

On page 5 of Exhibit 89 we have charted the individual back pressure lines of the several Texoma wells in Group 3-A, and we have also charted the composite back pressure line for the group. We proceeded to prepare this page, using the same kind of information and using it in the same manner as we did in the preparation of the previous
554 pages 2, 3 and 4. Sixteen wells are shown on the chart for Group 3-A, and we contemplate that a maximum of 13 additional wells will be drilled in that particular well group area.

All of the charts which I have talked about and which I am going to talk about from this exhibit are drawn on the same kind of paper and from the same character of data, obtained in the same way, as the data on the chart showing wells in Group 1 and shown on page 3 of the exhibit. All of the succeeding charts are similarly compiled.

The chart relating to well Group 3-B, on page 6 of the exhibit, shows the back pressure lines of each of the Texoma wells in that group, and the chart also shows the composite back pressure line which was determined for the Texoma wells in that particular well group.

The succeeding charts of back pressure test data relate to Groups Nos. 4, 5, 6, 7, 8, 9, 10, 11, and 12. Each of these group numbers in a group of Texoma wells. Each of the succeeding pages shows the back pressure lines for the wells in the respective groups and the determined composite line.

Turning back to the sample back pressure curve on page 2 of the exhibit, I can take that chart and find the open flow of the well whose back pressure curve is shown which we may expect to exist, if the conditions of the producing

formation remain the same, when the well pressure has dropped to about 100 pounds absolute in the formation.

I will illustrate the application of this particular pressure by citing the equation of 100 squared minus 13 squared. One hundred corresponds to P_t on the sample chart and 13 corresponds to P_s. One hundred squared is equal to 10,000, and 13 squared is equal to 169. The difference is so little less than 10,000 that for the purposes of answering the question I will use the value of 10,000. I find the figure 10 on the vertical scale of the sample chart and that is in correspondence with the pressure conditions stated in the question. I then proceed to the right along this line until we intersect the back pressure line of the well and then proceed downward to the scale for the quantity of daily open flow and read the figure 1.05, or in other words, 1,050,000 cubic feet per day will be the quantity of open flow which we may expect to find in this well at the time the pressure conditions are 100 pounds absolute in the formation. I can arrive at the potential for any given pressure by exactly the same process of computation.

In my actual studies in which I arrived at the future course of the producing capacities of these wells, I used calculations in determining the quantities that would correspond to rock pressures existing from time to time. The purpose of these charts is merely to show in a graphic way the same thing the calculations show. I think it would be impossible to describe this work without the charts. A pure statement of the calculations made would be very indefinite.

(At this point counsel for defendants offered EXHIBITS 89 and 90, and these exhibits were received in evidence without objection.)

555 I have been requested to explain for the record the practical use which Texoma and its production engineers and others employed in connection with gathering Texoma's gas make of these back pressure curves in the routine of their work.

I think to answer that question I ought to state why Texoma started making these back pressure tests. At first the company used the Pitot tube method of determining the open flow of its wells, but it saw that where it required a considerable length of time for a well to stabilize, it was improper to permit that well to continue blowing open to the atmosphere for that length of time. In the Aebersold No. 1-G, page 1 of Exhibit 89, we have a very definite indi-

cation of what would happen if we tried to determine the open flow of that well with the Pitot tube method and get an accurate answer.

For example, under the "Remarks" it is indicated that 24 hours elapsed between each test record. If we were working on the Pitot tube method we couldn't possibly let that well blow open to the air for three consecutive days because of the waste of gas, possibly because of the need for the production, and because of the danger of a fire or some other hazard developing during the period of three days. Furthermore, the Pitot tube method of testing revealed nothing as to the relationship of rock pressure and open flow. It told nothing as to what the operator could expect the well to produce if it had certain operating pressure conditions in the future, or even right concurrently as they went along from day to day.

For example, the meter charts from the various wells all pass over the desk of Mr. Galloup, who is superintendent of production, and he observes the registration that has been made on this particular chart, we will say the chart that belongs to the Aebersold well, and if it was a chart that had just been taken off the well, because of his experience, he is able to tell from this chart record whether that well is performing as it should be performing, and if there is something about the chart record that indicates to him the well is not doing properly, for example, not producing as much gas as it should for the pressure condition existing, he will turn to the back pressure data for that Aebersold well and check his conclusions which he reached when he observed the meter chart. If the comparison of the back pressure data and the meter chart shows that the well is doing as it should, there is no further action involved; but if the back pressure data indicates that the well is not producing as much as it should under the pressures recorded at the time the meter chart was in use, then Mr. Galloup can instruct one of his well operators to proceed to the field and blow that well and remove the water on cave-ins out of the well that have caused this deviation in the normal production.

In other words, they use this back pressure chart as the index to what the production ought to be, and when the production drops below that, that puts them on inquiry as to some trouble that exists that requires attention. They are also interested in the future open flow at a future rock pressure, because they want to know what the various wells

may be expected to do in current operation in the relatively near future.

556 Having worked out the relation between the open flow of the Texoma wells and the pressures of those wells, in order to predict the future producing capacity or potentials of these wells at given future times, we would have to develop the rock pressure situation in the future from year to year, and I have undertaken to develop the course of the rock pressures in Texoma's wells drilled and to be drilled in future years.

The first step in solving the particular problem as to rock pressure was to assemble the rock pressure data obtained from the various tests of the wells in the past. The Texas Railroad Commission makes a periodic rock pressure test of all the wells in the field, and open flow tests too, and also prior to the first Commission test Texoma had made various rock pressure tests and it has made rock pressure tests since the Commission's tests in 1938.

I have prepared tabulation showing the pressure information which we have had available either in the files of Texoma or those of the Texas Railroad Commission as to the past behavior of the pressures of Texoma's existing wells. We have prepared a rock pressure chart for each one of the same well groups that were referred to in the back pressure information and set out in Exhibit 90.

(At this point counsel for defendants presented a document entitled "Texoma Natural Gas Company, Rock Pressure of Wells in Various Groups." At the direction of the Examiner, the document was marked Exhibit 91 for identification.)

I am requested to state for the record what is contained in Exhibit 91.

This exhibit contains 13 pages, each page relating to a specific Texoma well group. As to a particular page, the page shows the rock pressure tests in the past of the Texoma wells in the well groups and the average from time to time of the rock pressure tests, and also the projection of this average into the future.

The Texoma wells on page 1 of Exhibit 91 are the same wells that are on page 3 of Exhibit 89, namely, the Texoma wells in well Group No. 1, and that is the situation with reference to each of the other well groups reflected by the charts shown in pages 2 to 13 inclusive.

The title of the chart which is page 1 of Exhibit 91 is "Rock Pressure of Wells, Texoma Natural Gas Company,

Group No. 1." The vertical scale on this chart is the wellhead rock pressure pounds per square inch gauge, and the numbers on the scale run from 20 pounds at the bottom to 420 pounds at the top. The horizontal scale on this chart is a time scale and is expressed in years. The numbers relating to the years are plotted on the chart at the midyear point of the year. For example, 1931 refers to the year 1931 and the position of the figures on the chart is at the midyear point or the midpoint of the space devoted to the year 1931.

557 The legend for this chart contains, first, a rather thin solid black line, named "Actual Test Data."

The next part of the legend is a heavier black line and it is named "Average of Test Data."

The third item in the legend is a broken black line and its name is "Average Weighted for Acreage."

The fourth item in the legend is a dot-dash line called "Estimated Future."

Next below the estimated future line we find a light black line, with a figure at each end of the line, namely, the figure 2, and this figure indicates the number that has been given to the particular well of Texoma in this group and is the same well No. 2 that is in the composite back pressure chart in Exhibit 89.

The balance of the legend says "Actual Test Data 1935 to 1938 Inclusive, from Texas Railroad Commission; Other Actual Data From Tests Made by Company."

In the upper left hand portion of the chart we find these thin solid black lines named in the legend as being the actual test data, and referring to that line which has the number 12 at the left-hand end and the number 12 at the right-hand end, the line is intended to join the charted wellhead pressures of the test that was made at the midyear of the various years, starting with 1933 and ending with the first of 1939.

Similarly, the other light solid black lines depict the trend of the rock pressure for the particular well. The rock pressure as of the date of the test is charted on the chart and then all of these points are connected by a light solid line.

I might say as to the January 1, 1939, line, this was taken from Texoma tests, and we do not have at this time any overall test records available.

The Railroad Commission's tests in the last several years have been made in the summer time, and in arriving at the

situation as it existed at the first of this year, to conform with other factual matter that is being prepared and has been prepared in this case, we had to use the company's tests as our control. We do not yet have available the mid-year 1939 tests of the Texas Railroad Commission.

I would say here the pressure indicated about the mid-year 1931 is an interpolation, in fact. The point of charting is about October, 1931, and it was at that time that the company's wells were coming into use for delivering gas to the Chicago project. They were so busy in the field that they were not able to make specific rock pressure tests right at that time, so we took tests that were made prior to that time and tests made subsequent to that time and interpolated the pressure as of October 1, 1931. Otherwise we have charted the actual data, and where we
558 say the tests are charted as of the midyear we mean to infer that the tests were made quite close to the midyear. It is impossible to test all wells simultaneously as of July 1st or any other date. The Railroad Commission usually makes its tests during the months of June and July.

Well No. 12 does not extend as far to the left as well No. 13 because well No. 2 is a Texoma well which was drilled about the middle of 1933, and consequently there would be no previous test record on this particular well. That would relate also to well No. 11 and possibly to other wells in the group.

The heavy solid black line which we find running down through the general center of the pattern traced by the individual well lines indicates the arithmetic average of the rock pressures taken as of various dates.

The broken heavy black line, which is in a position somewhat similar to the solid heavy black line, indicates the average pressure weighted for acreage. In other words, we took the pressure as of a specific time and weighted them for acerage and thereby determined an average rock pressure weighted for acreage. The acreage which we weighted into those pressures was that acreage which was taken into account in fixing the rate of withdrawals from that well.

If that well was located on a tract of 320 acres and was produced on a basis of allowing to the royalty owner production that would give him his proportion of the total withdrawals based on a 320 acreage factor or unit, we weighted the 320 acres to that well. We used the quantity

of acreage for each well that was used in the proration of the company's production to each well, regardless of the quantity of acreage to the specific well.

We commonly refer to the method used by Texoma in distributing its production over its producing properties as being the acreage-open flow method, and for abbreviated speech we just say A. O. F. By acreage-open flow we mean that the quantity of acreage assigned to the well and the open flow of the well are multiplied together to obtain a product for this particular well and then the products for each of the wells on production are added together to get the aggregate of all products. The individual well then gets its proportion determined by its product divided by the total of all products. This factor is multiplied by the total production to be prorated and we thereby arrive at the quantity for the specific well. We feel that this method of procedure gives each of our royalty owners a more fair share of the total outlet of the system than other methods.

As to the object of weighting the acreage into the pressures here and arriving at this average weighted pressure curve on page 1 of Exhibit 91, the trouble with using the arithmetic average of the rock pressures is that it does not take into consideration the fact that the wells are really located on acreage tracts of different sizes, and if we do not take into consideration the quantity of acreage in production we do not determine the true rock pressure condition in the Texoma producing property.

559 The idea is that by weighting in the acreage, all of the acreage which Texoma owns in the group, and arriving at this average weighted pressure, we will arrive at approximately the pressure at which a well would come in if drilled as of the time the test is reflected, whether that well be already drilled or not. There will be a very close comparison there. If a well be drilled in Group No. 1 at this time I would expect to find the pressure of that well within a close range of that weighted average pressure, and that would apply at any time throughout the course of years.

I have a line which I have described as a dot-dash line, extending from the right end of the broken line which represents the actual average weighted pressure history of the wells in that group, which I have labeled on the exhibit "Estimated Future." That line is a projection

of the average line weighted for acreage based on the past actual tests of the wells in the group projected from the first of 1939 to the end of 1954.

I will explain how I arrived at the course of that line. When we entered upon the problem of determining the future rock pressure decline of the Texoma wells, we felt that we should begin with the weighted average of January 1, 1939, because that was the average which reflected the then existing conditions in the group of Texoma wells. I needed some help on this particular problem, so I asked the Texoma geologists to assist in preparing a plan whereby we could determine the rock pressure of the Texoma wells in the future. I suggested that we might use the accumulative production per pound drop, but they told me in no uncertain terms that that method was simply out of the picture and that all of the usual methods in use for rock pressure projection were also out of the picture because they would not accurately reflect the conditions that existed in the Panhandle field as a whole, the differentials in pressure and content and facts of that kind.

As we continued to consider this problem we did not find any one method by which we could move forward from January 1, 1939, but we did come to the realization that we could correlate an estimate of the future recoverable reserves of the field and an estimate of the future annual withdrawals from the field and thereby determine the probable number of years that would be required to absorb the estimated recoverable reserves and would also arrive at the rock pressure that would exist when these recoverable reserves had been exhausted by production.

The field is being gradually drilled up. Other wells are being drilled out across the field, extending out from the lower pressures across the higher prevailing pressures. I notice from the weekly progress reports coming over my desk that some company has reported a well at another point and when I look at my acreage map I see that that is beyond where the production is currently coming. This drilling is spreading throughout the field. The wider the production is distributed throughout the field, the more nearly the rock pressures in the field will correspond throughout the field.

560 Mr. Peterson, the chief geologist of Texoma, has placed in evidence an estimate of recoverable gas

reserves in the Texas Panhandle field, and Mr. Dickinson, the Texoma superintendent of production, has placed in evidence an estimate of the future annual withdrawals from the Texas Panhandle field. The correlation of these estimates showed that the production estimated by Mr. Dickinson would exhaust the estimated recoverable reserves to a 25 pound wellhead gauge—these reserves as of January 1, 1939—before the end of the year 1952, provided, of course, that the wells in the field would produce the estimated quantities, having in mind that as lower and lower rock pressures come into the picture the wells in the field could produce less and less gas and the well drilling would have to be made at an accelerated rate in order to keep up with the estimated annual rate of withdrawals.

We realized that the field could not be expected, physically or economically, to produce year after year at full blast rate of annual withdrawal down to the very day that the accumulated production was equal to the estimated recoverable reserves at a 25 pound wellhead gauge. Therefore, we compensated for this condition by moving the 25 pound pressure from approximately the end of 1952 to the end of 1954. It was our judgment that the end of 1954 was the latest date at which there was any probability that the gas field average rock pressure would be as much as 25 pounds.

By following this correlation of estimates, we established the end of the productive period in so far as we were concerned, and also established the rock pressures existing at that time, and we therefore had a beginning point as of January 1, 1939, and an ending as of December 31, 1954, between which we must trace the path of the rock pressure decline.

I treated as the dividing point at the end of 1954, a pressure level of 25 pounds wellhead gauge. I do not mean to indicate that that is the limit and the final economic abandonment pressure. I think that there are many Texoma wells that will have to be abandoned prior to the time the field average gets to 25 pounds, and that will necessarily reduce the quantity of gas which Texoma can expect to obtain toward the end of the period indicated on the chart.

I projected my pressure down to 25 pounds, even though I do not believe Texoma will produce until it

reaches that point, because for the purpose of this study and our calculations we had to have a definite concluding date and we took this particular date as that definite concluding point. Possibly some of the Texoma wells will produce at that time.

After we had established the beginning point of our rock pressure decline in the future and the ending point of that decline, we found that we had the total amount of future rock pressure decline. We also had the total number of years during which we could expect Texoma would be in production. We also had the rock pressure decline during a recent period of time because of the fact that we had these rock pressure tests at the midyear of 1938 and at the beginning of 1939. We felt that this recent rock pressure decline was a good indication of the current conditions and of the immediate future.

561 We next considered whether the future rock pressure decline would be at an increasing rate or would continue at a constant rate. Inasmuch as the production from the field as a whole during recent years had been increasing and also because Mr. Dickinson's estimate was to the effect that the production of the field would continue to increase, we felt that the future rock pressure decline must be at a faster rate than in the immediate past.

If we were to assume that the rock pressure decline in the future will be uniform from year to year, that is, that the total rock pressure decline in the future is equal for each year in the future, we would be using the very method which our geologists had told us we could not use, namely, the correlation of accumulated production and of rock pressure decline. We concluded that the rock pressure decline in the future would be slightly faster from year to year.

With these conclusions at hand, we could have divided the total future rock pressure decline into yearly increments, each larger than the previous one, by simply doing what we call cutting and trying. However, there is a mathematical equation available wherewith we can find the amount of change from time to time and we can thereby determine the amount of increase in rock pressure decline from year to year in the future.

The use of this equation would aid us in our work. It would be quicker and the results obtained we thought

would be more definitely established. The equation to which I refer is that for an arithmetical progression. Such a progression is any series of numbers each of which exceeds or is less than the preceding number by the same amount of difference. We could set up the total of this series of numbers as being equal to the total future rock pressure decline. We could set up the number of figures in the series as being the number of periods of time in our estimate of the future. We could set up the increase in half yearly rock pressure decline as being the difference between each successive number in the series.

I will state that equation, but first I would rather name the letters in the equation and state what each letter refers to. The letter "S" is the sum of the members of the progression, or, in other words, it is the sum of all the half yearly rock pressure declines and is equal to the total rock pressure decline in the future. The letter "A" will be the first number of the series, that is, the rock pressure decline between the last two recorded pressures in our actual data. The letter "N" will represent the number of members in the series. That is the number of half yearly periods in the future. I say half yearly periods because our last two actual rock pressure dates are the middle of 1938 and the beginning of 1939, a span of half a year. The letter "D" indicates the difference between the successive members of the series, or, in other words, the increase in half yearly rock pressure decline. The equation of the arithmetic progression in the form

$$D = \frac{\frac{2S}{N} - 2A}{N - 1}.$$

in which we have used it is

562 We can illustrate the use of this equation by taking the data relating to a specific Texoma well group and giving numerical values to the various letters in the equation. I will take Group No. 1 as an illustration.

"S", the sum of the series, equals the difference between the weighted average rock pressure of this group of 270 pounds, January 1, 1939, and the assumed average rock pressure of 25 pounds at the end of 1954. This difference is 245 pounds. "A" equals 6 pounds and is the

difference between 276 pounds, which was the weighted average rock pressure at the middle of 1938, and 270 pounds, the weighted average rock pressure at the first of 1939. "N" is equal to 32 because the total period is 16 years and there are, therefore, 32 one-half year periods.

When we substitute these values in the equation and solve for "D" we find that the answer is one-tenth of one pound. This one-tenth of one pound is the increase in the half-yearly rock pressure decline from one half-year period to the succeeding half-year period.

Having determined the basis half-yearly decline, namely, the half-yearly decline in the immediate past, and also the increase in half-yearly decline in rock pressure, we were then able to establish the rock pressure decline which we would expect to exist at each of the succeeding half-yearly periods. For example, the first half-yearly pressure decline may be set at six pounds and, therefore, the second half-yearly rock pressure decline would be six plus one-tenth of one pound, or a total of six and one-tenth pounds. The third half-yearly decline would be six plus one-tenth plus another one-tenth, or a total of six and two-tenths pounds. Similarly we can determine the rock pressure decline in total for each of the succeeding half-yearly periods in the future.

We applied these determinations to the calculations of the total rock pressure as of any half-yearly period by starting out with the weighted average rock pressure as of January 1, 1939, and subtracting therefrom the first half-yearly decline, namely six pounds. That gave us a remainder pressure of 264 pounds.

We established the rock pressure at the end of the second half-yearly period by subtracting from 264 pounds the second member of the series which we had determined, or six and one-tenth pounds, thereby giving us a remainder of 257.9 pounds.

We proceeded in this manner throughout all the future half-yearly periods, determining the total rock pressure for each of the periods, and then placed these pressures on the chart and connected them by the dot-dash line which we have labeled "Estimated Future."

I have prepared a chart for each of the Texoma groups, and each chart is prepared in the same manner and using the same type of information as I have described in deal-

ing with Group 1. I used the same method of computation in arriving at the estimated future pressure decline for each of those groups, and proceeded in exactly the same manner in each group.

563 The line will not fall in each group on exactly the same rock pressure points because the beginning point of each group is different. In other words, the existing rock pressure conditions in each group are the determining factors for the beginning of the estimated future line in each group. Whether the line is a gradual decline or a more steep decline depends upon the weighted average pressure existing on January 1, 1939. I have used the same method of computation and exactly the same formula as I have stated by letters and explained.

I would like to say one thing, that in charting these rock pressure determinations we chart to the nearest half pound. We cannot chart to tenths of a pound on a scale like that.

Before leaving this chart, counsel has inquired as to the situation encountered in one of the areas where the pressures were high on January 1, 1939. Any group from No. 7 up will indicate a higher rock pressure as of the first of 1939. In fact, practically all the groups are higher than Group No. 1.

(July 27, 1939)

(Counsel for defendants made in open hearing the following statement:

If we may turn to Exhibit 89, I want to make a statement at this time. On the 13 charts, beginning on page 3 and extending for the next 12 pages of that exhibit, showing the general back pressure curves of Texoma wells concerning which the witness Bussard testified yesterday, due to some questions asked the witness by the Examiner, we have taken another look at those composite curves and we are now afraid that we have committed an error in the location of those curves in that they should have been located probably by platting in the average of the logarithms of the "Q" values instead of the arithmetic average of the "Q" values.

In the light of that circumstance, and due to the further circumstance that further testimony of that witness is related to those curves, we are going to ask the Examiner at this time to let us withdraw that witness, recompute and replat those curves, if we find they have been incorrectly plat-

ted, which will not cost any time because we are prepared to proceed with other testimony not related to those curves. We will go ahead with that testimony and recall this witness when that checking and correcting, if necessary, has been completed.)

564 R. T. POWERS, a witness for defendants, testified as follows:

Direct Examination by Mr. Hedrick.

(July 27, 1939.)

My name is R. T. Powers. I live at Fritch, Texas, and am 42 years of age.

I received the degree of Bachelor of Science in mechanical engineering from the University of Missouri in April, 1919. Prior to that time I was in the United States army for a period. After graduating from the University of Missouri, I entered the employ in May, 1919, of the Empire Gas & Fuel Company at Bartlesville, Oklahoma, as a junior engineer.

A junior engineer is a graduate of a technical school who is employed by that company to receive training in various phases of the operations of that particular company. He is assigned to work in as many of the various departments of the company as possible during the course of a period of training which usually extends upwards to two years. In my case it extended until January, 1921.

From January, 1921, until March, 1923, I was assigned as chief clerk of the auto service of the Empire Companies at Bartlesville. From March, 1923, to September, 1926, I was employed in the gasoline division of the Empire Companies at Bartlesville. My immediate superior was Mr. G. M. Davidson, who is now chief engineer of Natural Gas Pipeline Company and Texoma Natural Gas Company. I was engaged in design and construction work in connection with the construction of several natural gasoline plants.

From September, 1926, to April, 1927, while in the same department, I was at Seminole, Oklahoma, in direct charge of the construction of two natural gasoline plants. From April, 1927, to March, 1929, I was again at Bartlesville, Oklahoma, in the natural gasoline division, in responsible charge of natural gasoline plant design and construction.

From March, 1929, to June, 1930, I was employed in the general engineering department of the Empire Gas & Fuel Company at Bartlesville. This work involved general design work of the Empire Company's East Chicago refinery, including the design of a tail gas plant.

At a refinery considerable volumes of vapors are evolved in the distillation processes employed in refining crude oil, and in addition considerable volumes of vapors are evolved by evaporation unavoidably from stored petroleum products. The purpose of a tail gas plant is to recover and collect these vapors, and to recover the valuable hydrocarbon products, which are in the nature of gasoline, from these vapors. A tail gas plant is quite similar in construction and operation to a natural gasoline plant.

This brings me to June, 1930, when I entered the employ of the Continental Construction Corporation at Kan-
565 sas City, Missouri. My immediate superior at that time was Mr. S. E. Campbell, assistant chief engineer, who is now secretary of Natural Gas Pipeline Company and Texoma Natural Gas Company.

From June, 1930, until July, 1931, I was located in Kansas City in the office of the Continental Construction Corporation, and my duties were the design of compressor stations, by which I mean the compressor stations of Natural Gas Pipeline Company and Texoma, the selection of materials for these compressor stations, the preparation of specifications for the construction of these compressor stations, the letting of the contracts for the construction of the plants, the supervision of the construction of these compressor stations, and in addition the duties and responsibilities that were carried out in connection with the design and construction of the Fritch gasoline plant and dehydration plant, sometimes referred to as the refrigeration plant.

From July, 1931, to the present, I have been in charge of the operation of the Fritch compressor station and gasoline plant and dehydration plant. My immediate superior now is Mr. G. M. Davidson, chief engineer and superintendent of operations.

In connection with my duties as superintendent in charge of the operations of the compressor station at Fritch, Texas, the gasoline plant and the refrigeration plant, I have been involved with a great many problems concerning design and construction and operation of these facilities, and since March, 1923, I have been intimately

involved in problems of gas transportation, measurement and compression, with the extraction of natural gasoline from casinghead gas, and with the extraction of natural gasoline as practiced in connection with the transportation of natural gas from wells to markets.

(At this point counsel for defendants presented a photograph described as "Air View 303645, Compressor Station No. 1, Fritch, Texas." At the direction of the Examiner the photograph was marked Exhibit 92 for identification.)

Exhibit 92 represents the plant site occupied by the Fritch compressor station, gasoline plant and dehydration plant. This picture was taken during the winter of 1931 and 1932, shortly after operations were started. There have been additions to the buildings and improvements on the property since the picture was taken.

Several numbers running from 1 to 23 appear on this picture. Item No. 1 is the main compressor building. This building contains the 1250 horsepower gas engine driven gas compressor units. The building as shown there is 336 feet long, and is now 448 feet long. It is approximately 70 feet wide—I think it is either that or 68 feet.

Item No. 2 designates a black line on the picture which represents the exhaust stacks which serve the gas engines in the main compressor building.

Item No. 3 points generally at the piping manifold
566 between the main compressor building and the cooling tower, which is designated as Item 4. This means the gas piping manifold. Item 5 is the 100,000 gallon elevated water tank, which is made of steel. No. 6 is the office building.

No. 7 designates the cottage area which at that time contained 32 frame buildings used for the dwellings and bunk houses and boarding houses. At the present time there are 39 frame buildings in that area.

No. 8 is a 14 car garage used for the storage of employees' cars and for the storage of company cars and trucks. There are four of those buildings. The center one looks like one but is actually two. There are five at the present time.

Item 9 is the location of the loading rack where the natural gasoline manufactured by the gasoline plant is loaded in the tank cars for the market. It is completely surrounded and obscured by tank cars; but in the center of the string of tank cars is the loading rack.

No. 10 is the area used for the storage of pipe and materials.

No. 11 is the warehouse building known as the pipeline warehouse and garage. That serves the needs of the compressor station, gasoline plant and refrigeration plant for some materials, but it is mainly for the pipeline employees, and is under the direction of Mr. L. D. Williams, whose superior is Mr. R. G. Strong.

No. 12 is a 55,000 barrel reserve water storage tank, made of steel plate.

No. 13 includes forty size 11 feet diameter by 40 feet long horizontal cylindrical gasoline storage tanks, also made of steel plate. Gasoline is stored in those tanks. We have added no gasoline storage tanks. Adjacent to the storage tanks are certain facilities for storing small quantities of oil and some equipment for the treating of natural gasoline.

No. 14 is the laboratory building.

No. 15 is a small garage and warehouse used exclusively by the gasoline plant.

No. 16 designates the boiler stack, to the left of which is the boiler house in which are housed the steam boilers.

No. 17 is the cooling tower which serves the gasoline plant and refrigeration plant or dehydration plant.

No. 18 designates the miscellaneous equipment used in the recovery of natural gasoline—in other words, the distillation area.

No. 19 is the pump and recompressor building, in which are housed various pumps serving the gasoline plant and small 200 horsepower gas engine driven gas recompressors.

Recompressor is just a name that has been used in the
567 gasoline business for a long time for the compressors that serve a natural gasoline plant. They are called recompressors generally.

No. 20 represents the nine absorbers in which the natural gas, after it has been compressed by the compressor station, is contacted with an absorbing oil for the removal of its natural gasoline content.

No. 21 is the dehydration equipment where the water vapor content of the natural gas is reduced.

No. 22 is an earthen pit used for the reception of oil and waste matter blown from certain drips.

No. 23 is the five dust scrubbers on the incoming gas lines.

The long black line extending from No. 1 to No. 16

represents an overhead steam line used for conveying heating steam from the boiler house to the compressor station. There are actually two lines there, an eight inch steam line and a two inch condensate return line.

The black lines which seem to encircle the plant site, both on the lower side and the right side, represent our fence line. Around the field is the fence line, and the black lines are furrows. I think the farmer was plowing at the time the picture was taken.

The white lines extending from the left center of the page toward the top and to the right and around in among the buildings are roads serving the various facilities and the cottage area.

Over in the distance towards the top of the picture there are some hills and a river. Those hills are known as the Canadian River breaks, and the river is the Canadian River.

The plant site contains 80 acres. It is half a mile long and a fourth of a mile wide. We have not added any lands. We have built our additions inside the present acreage fence line.

(At this point counsel for defendants offered EXHIBIT 92 in evidence and it was received without objection.

Counsel for defendants then presented a document described as "Texoma Natural Gas Company, Additional Capital Expenditures, Compressor Station, Gasoline Plant, Refrigeration Plant. Witness R. T. Powers." At the direction of the Examiner, the document was marked Exhibit 93 for identification.)

Exhibit 93 generally represents a statement of the additional capital expenditures which will be required for the Fritch compressor station, gasoline plant and refrigeration plant during the period from January 1, 1939, to 1954.

The first page of this exhibit is not numbered, but
568 the succeeding pages are numbered down to 26. The first line on the first page of the exhibit, entitled "Compressor Station," is a recapitulation of the expenditures that will be required by the compressor station and shown in more detail on page 1 of the exhibit. The second line, entitled "Gasoline Plant," is explained more in detail on page 13 of the exhibit. The third line, entitled "Refrigeration Plant," is explained more in detail on page 21 of the exhibit; and the laboratory apparatus is explained more in detail on page 14 of the exhibit.

The next subdivision on the first page is entitled "Book

Cost of Property Retired," and has reference to the book value of the equipment reclaimed or retired from investment, as shown by the books of the company. In other words, when we make an expenditure that take the place of some equipment that we now have, the equipment that we now have is retired in accordance with the actual book cost of that particular equipment.

The compressor station, gasoline plant, refrigeration plant and laboratory apparatus retirements are shown more in detail on pages 1, 13, 21 and 14, respectively, of Exhibit 93.

The next subheading is entitled "Salvage" and means the credit or salvage value received for any equipment retired from investment which has value for further use. In other words, when we retire property from investment we place a value called salvage value on that equipment, and that salvage value is also shown in the exhibit. Under the word "salvage" is listed the salvage value of retired property of the compressor station and the gasoline plant, the details of which are shown at page 1 and page 13, respectively. There is no salvage for the refrigeration plant and laboratory apparatus. Those figures represent gross salvage.

It is rather difficult to answer whether or not in preparing the figures presented by this exhibit, where salvage property is reused, we figured the cost of the new investment of that property salvaged as the actual salvage value, instead of the cost new of articles which we put into new equipment. That is an accounting matter with which I am not familiar. However, if we reclaim a pipeline on the compressor station site and use it somewhere else, it is my understanding that the new job is charged for the pipe at the cost of new pipe.

If we install a piece of pipe on the plant site which we have salvaged, we use the salvage value of the pipe. In my previous statement I had reference to using the current price for pipe salvaged and considered suitable for re-use. That is an accounting matter with which, as I said, I am not familiar. We do use salvaged property where it is re-used at the salvage value. When we reclaim a section of pipe and that pipe is considered suitable for use elsewhere, the accounting department is informed to that effect and in charging the reclaimed pipe to the new job they use a certain salvage value in making that account. That value is arrived at in various ways. I think as we

proceed we will find the salvage value for equipment
569 is sometimes the trade in value, as in trading in an automobile, and in the case of pipe I think one example occurs of some two inch pipe reclaimed this year to which a salvage value was assigned which is very close to the current price for two inch pipe. That salvage value was assigned to that pipe because it was in good condition and suitable for re-use.

Turning to page 1 of the exhibit entitled "Texoma Natural Gas Company, Compressor Station Department, Additional Capital Expenditures and Book Cost of Property Retired," the line numbered 1 is entitled "Dwelling Houses and Facilities"; line 2, "Equipment"; line 3, "Auxiliary Engines"; line 4, "Main Engines"; line 5, "Station Piping"; and line 6, "Buildings and Grounds." The expenditures for each one of those items are shown in more detail on pages 2, 3, 4, 5, 6, and 7, respectively, of the exhibit.

The items under the subheading "Book Cost of Property Retired," lines 8 to 12, inclusive, entitled "Dwelling Houses and Facilities, Equipment, Main Engines, Station Piping, Buildings and Grounds," are shown more in detail on pages 8 to 12, inclusive, of the exhibit.

The items under the subheading "Salvage," lines 14 and 15, entitled "Equipment" and "Buildings and Grounds," are shown more in detail on pages 9 and 12 of the exhibit.

Turning to page 2 of Exhibit 93, I will explain the necessity for the expenditure of $8,202 in 1939 for the construction of two 4 room cottages for the operating department. It has been the policy of the management to provide housing facilities for certain of the employees in the salaried class above that of the employee known as oiler. In accordance with this policy it is necessary from time to time to construct cottages for those employees as they become eligible for this accommodation. At this time two houses are being constructed for station and gasoline plant operators.

(Counsel here pointed out that the exhibit had to be started at some date, so it was started as of the first of 1939, and many of the items had already been installed.)

That first item is for the operators of the plants over which I am superintendent.

The second line says "Construct one 4-room cottage for pipeline." The necessity for that expenditure of $4,101.00 in 1939 is that it is my responsibility to maintain all of the

equipment on the plant site and to supervise the construction of additions to the facilities on the plant site. It is necessary to provide accommodations at this point for the employees of the pipeline department. I have therefore been instructed to arrange for the construction of one 4-room cottage for a pipeline department employee this year, and this cottage is now under construction.

Throughout this exhibit concerning additional capital expenditures, we use current prices as of June, 1939, for the equipment and labor going into these additional capital expenditures referred to in this exhibit.

570 Lines 3 to 10 inclusive are generally the same, and I will explain the necessity for the construction of the various cottages for our own operators and for the pipeline department, ending with an expenditure in 1949 of $3,815.00 for the construction of a 4-room cottage for the pipeline department.

With reference to the one 4-room cottage for the pipeline in 1940, the statement which I just made with reference to the pipeline cottage being constructed this year applies generally. I have been instructed by the chief engineer to allow in this statement for the construction of certain cottages to serve the pipeline department employees, which include one 4-room cottage in 1940, one 4-room cottage in 1941, four 4-room cottages in 1942, two 4-room cottages in 1944, two 4-room cottages in 1947, and one 4-room cottage in 1949.

Items 11 to 16 inclusive are for the construction of garages and garage stalls.

In 1940 it will be necessary to construct two cottages for operators at the Fritch compressor station, gasoline plant and dehydration plant. That is for the reason that a program has been formed for constructing cottages as convenient to accommodate those employees now eligible or who are expected to become eligible in accordance with this program. We have from time to time employed numerous single men, and as time has passed they have become married and their situation demanded that they be provided with cottages. Heretofore the single men lived in bunk houses on the plant site, and they do at the present time. In a good many instances since the beginning of operations of Texoma single men have become married and now have families, and cottages must be provided for them.

The Fair Labor Standards Act of the Federal Government has had an influence upon the number of employees

employed by Texoma, and it has an effect on the number of cottages required. It has had a very great effect. We originally based our operating schedule upon a 56 hour week, and are now using the 40 hour week. The number of cottages as shown on Exhibit 92 was planned and based on the 56 hour work week for the station and gasoline plant operators. In 1933, we changed to the 40 hour week for the operators and have continued that in effect since that time. This change necessitated hiring a considerable number of additional employees, and, in addition, the plant extensions which have been made necessitated the hiring of a considerable number of additional employees. The pipeline department's work has expanded similarly.

The condition at Fritch, Texas, with reference to housing facilities is that they have a few very poor houses. They are not good sized comfortable houses that would make an employee contented to stay there. In general I would call them two or three room shacks, not at all weather-proof and very uncomfortable. There is a demand among the employees at the station for suitable housing. The closest town of any size to Fritch is Borger, Texas, and that is 17 miles away. Pampa is something over 50 miles, and Amarillo is 37 miles.

571 In case of an emergency occurring at the station, such as a fire or a breakdown, it is desirable that all employees be immediately available.

My explanation for the additional cottages for the operators in 1940 was intended also to apply to the program which contemplates the construction of two cottages in 1941 for the operators. In 1939 these cottages cost approximately $4100 apiece, as shown in line 2, and over in 1949 and 1941 a 4-room cottage is listed as costing $3815. The difference is that the cost shown for 1939 and 1940 includes the cost of certain necessary additions to sidewalks, roads and curbing, which will be necessary, due to the nature of the lay-out of the cottage facilities, but which will not be necessary in the case of the cottages constructed thereafter.

The explanation I have given for the construction of these cottages down to 1941 applies to the expenditures down to the construction of the one 4-room cottage for the pipeline in 1949.

Items 11 to 16 refer to the construction of garages and additional stalls to garages. It is the management's policy to furnish garage stalls for the storage of the em-

ployees' cars and, in addition, it is necessary to construct additional garage stalls for the storage of company cars and trucks as additional employees are added to the personnel. The expenditures for garages and additional stalls to garages in 1940, 1941, 1942, 1944, 1947 and 1949 are necessary to accommodate the occupants of the cottages which will be constructed usually in the current year. In 1940, however, we will construct two garage stalls to serve two of the cottages being constructed this year. That work has been deferred until 1940. In addition to constructing a garage stall for the personal car of the employee, it is frequently necessary also to add a garage stall to accommodate a company car which will be assigned to him.

Item 17 is entitled "Construct 10 by 26 by 8 Foot Septic Tank" in 1942 at an expenditure of $1,808. The sewage disposal at the present cottage area is carried out by the use of a septic tank. This septic tank is undersized and badly overloaded. It will be necessary, in order to handle the additional sewage incident to the addition of the cottages enumerated, to add an additional septic tank by 1942.

Item 18 is entitled "Construct Additional Lighting Transformer, Wiring, Etc.," with an expenditure in 1939 of $1,498. This work is now in progress.

In the preparation of the information contained on page 2 I have carefully considered the number of employees that are housed at the Fritch plant and the living conditions in the vicinity of Fritch and the number of employees we will have in the future in arriving at these figures, and this is my best judgment as to the expenditures that will be necessary in these years for this particular item of dwelling houses and facilities.

572 Page 3 is entitled "Additional Capital Expenditure —Equipment." The first item is "Construct Annealing Furnace." An annealing furnace is a furnace or oven heated by a gas fire, in which cast iron engine parts which have cracked are pre-heated, in preparation for repair by welding, and after welding are carefully annealed. Due to the situation with reference to cracked parts of the engines, it is necessary to enter into a program of repair of those parts, and in order to do that properly it will be necessary to construct this annealing furnace in 1939 at an expenditure of $581. In general, by cracked parts of

engines I refer to the Worthington engine power cylinders, to Worthington engine power cylinder heads, and to Worthington engine exhaust valve casings.

A Worthington power cylinder weighs in the neighborhood of six tons. We have had some of those crack in the past, not only in our own plant, but others have been cracked in the other compressor stations. We have not been handling those things. It has been done at one of the other stations at this Illinois end of the line, and we desire to enter into that program at our own station. We find it more economical to do that rather than discard the cylinders or the equipment and buy new.

Item 2 is "Purchase of 400 Ampere Arc Welder." This machine is a generator used in welding the pipelines and machinery parts and in general welding around the station. The present welding machine which is now in use is deteriorating and it is my judgment that this machine must be replaced not later than 1942. In other words, this item is scheduled for the year 1942, but the expenditure may be made prior to that time.

Item 3 represents an expenditure of $1,485, and that has been installed. Item 4 has been installed. Item 5 calls for the installation of three additional dust scrubbers to be installed nearby No. 23 on Exhibit 92.

A dust scrubber is a large tank installed on a natural gas line, on the intake side of the compressor station. It is provided with suitable internal baffles, and its function is to effectively separate out of the gas stream any foreign matter such as dust, dirt, rust, scale and liquid. The present installation of dust scrubbers at this station is inadequate to perform this function in a satisfactory and safe manner, and it will be necessary to install three additional dust scrubbers in order to properly protect the compressor station equipment. It has been the general experience that as the wells of Texoma age and the pipeline of the company ages, these foreign materials which will be separated from the gas stream by the dust scrubbers will increase in quantity. We have heard of other pipelines and know of other pipelines which have had that experience in the Panhandle field, as well as our own.

Items 6, 7, and 8 have been purchased. Item 9 provides for the purchase of a grinder for the machine shop. This is an electric motor driven grinding machine, subject to extremely hard usage, and the condition of the present

machine is such that in my judgment it must be replaced not later than 1940.

Item 10 provides for the purchase of three chain
573 hoists. These chain hoists will be used for the purpose of replacing chain hoists now in use and which are deteriorating to the extent that in my judgment they must be replaced not later than 1940. These chain hoists weigh from one to two tons each, and it is extremely dangerous to the men who are using these chain hoists to operate them if there is any likelihood of their deteriorating or breaking.

Going back to Item 3, entitled "Install Three Additional Dust Scrubbers," I will explain what would be the result if this scale, sand and foreign material were to pass from the pipeline into the engines and equipment.

If this scale, rust and foreign material and liquids are allowed to enter the engines they will, of course, contact the compressor cylinder walls and the compressor piston rings, causing excessive and very costly wear on those parts. In the operation of this gathering system it has been our experience that during cold weather appreciable volumes of drip gasoline, which is gasoline condensed out in the pipeline after the gas leaves the wells, will enter the station and will pass through this present dust scrubber installation and actually enter the cylinders in the form of a fine mist or spray, which has a very harmful effect upon compressor cylinders and compressor rings, due to the fact that this gasoline liquid tends to completely destroy the lubricating oil film on the cylinder walls.

Item 11 is entitled "Purchase Model 55 Western Voltmeter." This is merely a test voltmeter which is necessary for use in making various tests of electrical equipment throughout the plant. The necessity for this instrument has been demonstrated on very many occasions, due to trouble with our electrical equipment, and the necessity for checking voltages. We have ordinarily had to send to one of the adjacent towns and on many occasions have had to borrow voltmeters for that purpose.

Item 12 provides for the installation of an 18 inch by 10 feet lathe in the machine shop in the year 1941. The purpose of this installation is to replace the present lathe, which has been in service since 1931, and which has been subjected to extremely heavy usage almost continuously during the past four or five years. It is my judgment that

in 1941 that lathe will have become so deteriorated that it will have to be replaced.

Item 13 provides for the installation of a 28 inch drill press in the machine shop. The purpose of this installation is to replace a similar drill press now in service, which has been in service since 1931 and which in my judgment will have become so badly worn that it cannot be used beyond the year 1941 and will have to be replaced at that time, if not sooner.

Item 14 provides for the installation of a No. 3 air compressor. At the present time this compressor station is served by two air compressors. This is the same number and the same size installation as utilized at each of the main line compressor stations, and the demand for compressed air at the Fritch compressor station and
574 gasoline plant, which are jointly served by these two compressors, is so great that, in the interest of safety and in order to maintain an adequate supply of compressed air at all times, it will be necessary to install a third air compressor. If the air compressor units were to break down, we would have to use an emergency compressor which is installed at the gasoline plant, which is operated by steam. This emergency compressor is held in reserve for just such occasions; and it is not to be used for routine operations. This air compressor will have to be installed in 1940 at a cost of $2,542.

Item 15 provides for the installation of a Zeolite water softener in the year 1940 at a cost of $9,710. A Zeolite water softener is a device employed to soften the water which is used for the purpose of cooling the various processes, or cooling the various engines throughout the Fritch gasoline plant and compressor station. The present water softener is inadequate in capacity to supply all of the water needed by these plants. At the present time some experiments are being conducted with chemicals which are added directly to the water for the purpose of softening it. However, these experiments have not been successful, and it is my judgment that the present water softening equipment must be supplemented by an additional unit in 1940 in order to provide the necessary supply of soft water.

A sufficient supply of soft water is necessary in the operation of the equipment at the compressor station and gasoline plant for the reason that if unsoftened water, or

hard water, were used, the scale accumulations in the engine jackets and in the various other cooling equipment would soon become so heavy, and the cost of removal of these scale accumulations would become so heavy, that plant operations would be seriously hampered if not altogether interrupted. The degree of hardness of the water we have down there now is about 15 grains per gallon, and that is too hard for proper operation of our plant.

Item 16 provides for the installation of a water filtration plant in 1940 at a cost of $4,512. During the winter and spring seasons of the year, high winds prevail in this region and dust storms are frequently experienced. These storms are of varying intensity. However, in the operation of the plant and in the operation of the cooling towers serving the compressor station and gasoline plant, we find that the water circulated over the top of the cooling towers, which is broken into a spray or rain of water as it descends to the base of the towers, serves to catch immense quantities of dust borne by the winds.

As a consequence, the water which is circulated over these towers and over the cooling sections and through the engine cooling jackets becomes heavily laden with suspended matter. In other words, it becomes muddy. This mud will settle out in the engine jackets in very great quantities, seriously affecting heat transfer efficiencies and causing great expense in the matter of cleaning for the removal of these mud deposits.

I have been asked to explain the intensity of the dust storms that we have around Fritch, not only on account of Item 16 but also because we have in this exhibit other
expenditures to be made on account of the dust situa-
575 tion at Fritch. It has become customary to speak of dust storms by referring to visibility which prevails during the course of the storm. On innumerable occasions visibility has been reduced to less than 100 yards by these dust storms, which means, of course, that you can't see over 100 yards in broad daylight. On some occasions the storms have been so intense that automobile traffic on the roads has been completely stopped, due to the fact that the drivers could not see their way. It has been the experience in this region that on a few occasions it has been necessary to shut down certain plants because of this dust.

In May, 1936, I prepared and read a paper entitled

"Dust Proofing Compressor Stations" at the Natural Gas Section meeting of the American Gas Association in Dallas, Texas. I think it was May 8 or 9, 1936. That paper is shown in the printed reports of the American Gas Association.

I was pointing out the fact that circulating water becomes extremely muddy, and we have conducted certain laboratory experiments which indicate to us that the clarification of this water can be effected by the use of a filtration plant. It is therefore proposed to install a filtration plant for the purpose of clarifying this muddy water, in the year 1940, at a cost of $4,512. The filter is commonly described, I believe, as a pressure type sand filter.

Item 17 provides for installing a taper attachment on lathe in 1940 at a cost of $225.. Certain machine operations carried out in the machine shop of the compressor station call for the use of a taper attachment on the lathe. This taper attachment is used to facilitate necessary taper turning. The lathes originally purchased and installed were not equipped with taper attachments. It will be necessary, therefore, to purchase one taper attachment in 1940. We have a considerable amount of work to be performed in and about the plant with a taper attachment. If we have tapering work to be done now which must be of ordinary accuracy, we send the work to a machine shop in Amarillo, at considerable excess expense.

Item 18 provides for the installation of a 125 ton portable hydraulic forcing press in 1940 at cost of $725. This is another item of machine shop equipment which was omitted from the original installation and which is considered indispensable. The need for such a press has become more and more evident as plant maintenance programs have been heavier with the increasing age of plant equipment. Such a press is needed for removing sprockets and gears from shafts, for pressing bushings into housings, and for dismantling various assemblies, which work is now effected by various crude and time-consuming operations with hydraulic jacks or by the use of a 16 pound sledge. We occasionally break some of our equipment with the 16 pound sledge.

Item 19 provides for the purchase of metallizing equipment in the year 1940 at a cost of $550. Metallizing equipment is equipment employed in building up worn

parts, worn metal parts, by the addition of a spray
576 of molten metal. Observation of metallized wearing parts in service on equipment similar to that employed at Fritch and experience with metallized wearing parts at other stations on our pipeline has indicated the practicability of this method of repair.

At the present time the rate of wear of piston rods of the gas engine driven compressors is such as to indicate the desirability of rebuilding the worn rods or replacing them with new material. It has been found that metallizing, or building up by the application of sprayed metal, can be safely performed and will prolong the life of the part to a very great extent.

If we do not have this equipment, the worn parts would ordinarily be discarded and replaced by new parts. I have taken this item into consideration in the cost of maintenance of the plant in an exhibit to which I will later testify; and that is true with reference to these other labor and material saving devices to which I have testified.

Item 20 provides for the installation of a replacement bottom in the 100,000 gallon elevated water tank. This tank is designated on Exhibit 92 as No. 5. This replacement bottom in my judgment must be installed not later than 1942 at a cost of $2,622. The present condition of this bottom is that it has corroded at a serious rate. Due to the shape of the bottom of this tank, mud deposits from this water to which I have previously referred settle on the metal surface, and this deposit of mud causes accelerated corrosion to take place. It is my judgment that this corrosion will have proceeded to such an extent that replacement must be made in 1942. In one of the other compressor stations of Natural Gas Pipeline Company under the supervision of Mr. W. H. Davidson, one tank bottom like this was replaced last year.

Item 21 provides for the installation of a Thomas Recording Calorimeter in 1944 at a cost of $2,162. The function of a Thomas Recording Calorimeter is to make a continuous record of the heating value of natural gas. A Thomas Recording Calorimeter has been in continuous service at this station since 1931. This instrument is constantly in use for checking the heating value of the gas entering the compressor station from the gas wells and

of gas discharged from the gasoline and dehydration plants after having been denuded of its gasoline content.

This instrument contains much equipment which operates continuously in a water bath, and which is accordingly subjected to a considerable degree of wear and corrosion. It is my judgment that this equipment, plus the electrical recording device, will have completely worn out or have been corroded beyond further use not later than 1944. I am required by contracts which Texoma Natural Gas Company has to determine and record the heating value of the gas as it passes through this plant.

Item 22 provides for the installation of a Goulds oil centrifuge in 1946 at a cost of $1,616. The condition
577 of the circulating oil used for bearing lubrication for the gas engine driven compressors became very bad during the first years of operation from various causes, including the prevalent dust storms. In 1936 a centrifuge was purchased, and this machine has been in continuous operation for the purpose of cleaning this oil and removing contaminated matter therefrom. In other words, we are able to re-use the oil that is used in the machinery, in the compressor engines and other engines by cleaning it with this oil centrifuge machine at a considerable saving in the cost of oil. The centrifuge machine operates at a very high speed. Its speed is approximately 6,600 revolutions per minute, and it is subject to considerable wear for that reason. In addition, a considerable amount of corrosion takes place in certain parts of the machine. It is my judgment that the machine now in operation will have deteriorated to such an extent that it must be replaced not later than 1946.

Item 23 provides for the installation of four G. R. gas coolers. G. R. stands for the name Grisoom-Russell, which is the name of the manufacturer of the gas cooling equipment used at this station. In 1946, as will be later shown, it will be necessary to install one additional Worthington 1250 horsepower gas engine driven gas compressor, and in order to serve this gas compressor the four gas coolers shown under Item 23 will be required.

By reason of the compression of the gas, the gas compressed by the compressor systems leaves the compressor cylinders at a temperature which ranges between 250 and 270 degrees Fahrenheit. The gas must be cooled for various reasons. If it were not cooled serious difficulties

would result, one being in the destruction of the paint on the 24 inch pipeline which carries the gas from the compressor station to the gasoline plant. Serious difficulties would be encountered in the expansion and contraction of this 24 inch pipeline with changes in this temperature which would occur in case of a plant shut-down, for example, when the line would cool off. In addition, the necessary functions of removing the natural gasoline content from the gas, and the functions of dehydrating the gas, could not be performed if the gas were not cooled.

With reference to Exhibit 92, the gas coolers are located inside of and in the base of the cooling tower, which is No. 4. A gas cooler consists of two cast steel, box-like headers. A header in this instance is shaped roughly like a parallelepiped. It is a long box. In other words, the gas from the compressors comes out in a large diameter pipe and must be transferred from this large pipe to smaller pipes.

The gas cooler consists of two of these headers or boxes made of cast steel. The gas enters this header and from the header it enters a number of one-inch outside diameter brass tubes. Each tube is 20 feet long. These tubes may be roughly described as brass, but we describe them generally as admiralty metal. The two headers, one at each end of the gas cooling section, are joined, therefore, by a number of those one-inch O.D. admiralty metal tubes. I think in this particular instance there are approximately 88 of these tubes. The wall thickness of the admiralty metal used in constructing these tubes is 1/16 of an inch.

578 The gas enters one header, one side of one header, passes through a group of these one inch admiralty metal tubes lying in a horizontal position into the header at the other end of the one inch brass tubes and returns along the other side through the other group of one inch admiralty metal tubes. The admiralty metal tubes of such length are extremely flexible and in order to provide sufficient rigidity as between the two cast steel headers on each side is installed a rolled steel channel to which each end of each header is attached. In effecting the cooling the water which descends from the top of the cooling tower in the form of a shower falls upon the bundle of one inch brass tubes and cools the gas which is passing through the inside of those tubes.

Item 24 is a 200,000 gallon elevated water tank, which it will be necessary to install in 1946 at a cost of $17,309. The purpose of the present 100,000 gallon elevated water storage tank at the Fritch compressor station is to provide a reserve water storage volume to be drawn upon in periods of unusually high demand for make-up water or for additional water in the cooling system, which may occur during the course of an extremely severe windstorm, which tends to blow great quantities of water out of the cooling towers.

In addition, the function of this 100,000 gallon tank is to provide a supply of cooling water for the necessary cooling of the operating gas engines in the event of the failure of a water pump. Should a water pump fail or stop, the supply of water for cooling the engines would be immediately interrupted were it not for the water stored in this elevated tank, and should this supply of cooling water be interrupted, the engines would probably be damaged beyond possible repair.

When a pump stops, the water in the present 100,000 gallon elevated tank will be drained through the engine jackets and thereby provide the necessary cooling during a short period of time. At the present time and with the present operating schedule, the supply of water stored in the 100,000 gallon elevated tank amounts to enough to maintain satisfactory cooling of the engines for approximately 13 minutes only. This means that in case of a pump failure requiring not more than 13 minutes to repair, the station can continue its operating schedule without interruption. At the end of 13 minutes everything would have to discontinue operation until the pump could be repaired. It is my judgment that at the present time we are operating on the borderline of safety inasmuch as practice in the industry generally is to provide water storage to care for an interruption of service by the water pumps of at least 30 minutes duration, and oftentimes longer. At the time the additional gas engine driven compressor is installed it will be necessary to install a larger tank in order to provide the desired and necessary protection to the equipment. That is the Worthington unit No. 16, shown on page 5, for which a gas cooler is supposed to be provided.

Item 25 provides for the erection of one 180 foot cooling tower in the year 1948. It is my judgment that it will be

necessary to replace the cooling tower designated as No. 4 on Exhibit 92, and which was erected in 1931, in the year 1948. Experience with cooling towers installed on this pipeline system, as well as with those installed on other systems, indicates that the original redwood open type
579 louvre cooling tower will deteriorate in from fifteen to seventeen years to such an extent that replacement will be necessary. High winds together with ice formations in cold weather tend to seriously weaken the structure, causing the framework to become loose and seriously affecting the connecting bolts.

The present cooling towers have required considerable amounts of repair work and will continue to require repair. Consequently, it will be necessary not later than 1948 to completely replace that tower. Another factor contributing to the deterioration of the cooling tower is the vibration transmitted from the gas compressors to the gas coolers, which are supported by the lower portion of the cooling tower, and which also adds greatly to the tendency to loosen the framework.

Item 26 provides for the installation of 28—C-240 gas coolers in the year 1946, at a cost of $33,028. As described previously, the gas coolers are installed in the base of the cooling tower where they receive a constant shower of cooling water. The compressed gas entering these tubular coolers at a temperature of approximately 250 to 270 degrees Fahrenheit is cooled in this process to a reasonably close approach to the temperature of the cooling water.

The cooling sections are subjected to the full high pressure, discharge pressure of the gas compressors, amounting to 740 pounds per square inch gauge and are subjected to a great amount of vibration and to pulsations transmitted from the compressors. Experience with this type of equipment and with the service to which it is subjected indicates the safe working life of the tubular elements and of the tube headers is limited. The tubes are constantly vibrating, which induces wear between the tubes and the supports for the tubes as well as between adjacent tubes. Vibration induces fatigue in the tubes, and corrosion is proceeding on the external surfaces of the cast steel headers, on the channel members, and on the steel bolts holding the various parts together, due to the nature of the cooling water, which is highly alkaline. Effective protection from the corrosive action of the cooling water has not been developed. Furthermore, there is a likelihood that the

admiralty metal tubes are undergoing weakening due to dezincification and embrittlement.

The metal zinc is contained in this admiralty metal, and by dezincification I mean that the corrosive action of the water has eaten out the zinc from that metal. In dezincification the attack from the water results in removal by the water of the zinc from the alloy, leaving porous masses or layers of copper. The metal of the tube wall is 1/16 of an inch thick.

The gas inside the gas coolers is at a pressure of 740 pounds per square inch gauge. Numerous replacements of the admiralty metal tubes have already been made due to wear. For the sake of safe operating conditions, and for the reliability of operations and freedom from disastrous failures, it will be necessary to allow for the replacement of these original gas coolers, which were installed in 1931.

Item 27 provides for the installation of 12—A-240 580 gas coolers. The necessity for the installation of those gas coolers is precisely the same as for Item 26. These coolers to be replaced under Item 27 were installed in 1935, and it is my judgment that they must be replaced not later than 1950. They are the same type of coolers, but, as indicated, they are slightly different due to the fact that they have different numbers. They have a slightly different number of tubes, but the cooling surface provided in the assembly is approximately in proportion to the amount of gas handled by the compressors which they serve.

The installation of the 28 coolers in 1946 is to replace those installed in 1931 to serve the twelve compressors, and the replacement of the 12 coolers in 1950 is to replace those that were installed in 1935 to serve the additional three compressors that were installed.

Item 28 provides for the installation of dust protection equipment to serve the auxiliary building. The auxiliary building houses the gas engine driven electric generating equipment, the machine shop equipment, the locker room, various storage facilities, and the water pumping equipment. On Exhibit 92 the auxiliary building has not been numbered, but it is the building right above No. 1, a smaller building right next to the main building.

The installation of dust protection equipment on the main compressor building of the station at Fritch, as well as the station known as No. 2 and the station known as No. 3, has been highly successful in combating the dust

conditions and in excluding a very considerable amount of the wind borne dust from the main compressor building. In order to provide similar protection to the machinery and equipment in the auxiliary building, it will be necessary to install dust protection equipment in the year 1939 at a cost of $2,070.

The dust protection equipment consists of a large blower and in addition a housing for the blower equipment, which equipment filters from the air to be handled by the blower all dust, this being usually accomplished by the use of a water spray. The outside air is drawn into the dust protection equipment. The dust is filtered or washed from the air and the blowers force the clean air into the building to be protected. This has a tendency to exclude practically all the dust which would otherwise enter the building during the course of the frequent dust storms.

The blower creates a slight pressure within the building. To keep the dust out of the building which might come in through the cracks of the corrugated iron roof and siding, we have installed on the main compressor building a large amount of sealing materials, such as felt strips, to seal the various cracks in the building structure, and in addition on some buildings the longitudinal lap joints of the corrugated iron covering have been soldered. This is considered entirely successful in conjunction with the blower and filtration equipment; but without the blower and filtration equipment it has not heretofore been successful.

Item 29 covers the purchase of miscellaneous tools, instruments, jigs and appliances which are necessary in
581 routine operation and maintenance activities. As these tools wear out they must be replaced by new equipment, and as our maintenance problems continue, additional equipment of a new or improved character will be required. It is my judgment that an allowance as indicated under Item 29 must be made for the purchase of miscellaneous tools, instruments, jigs and appliances. I mean that the cost of maintenance and the labor and material involved will increase in future years and it will be necessary that additional tool equipment be purchased in increasing amounts in future years. That will be disclosed, I think, in the next exhibit. However, essentially this item provides for a great many necessary replacements plus new equipment and tools for operations which may have been carried on in a makeshift manner in the past. This expenditure is in addition to the items provided for in my

exhibit which will describe the cost of maintenance and operation in the future.

Item 30 is "Install Gauge Glasses on Dust Scrubbers." This installation is now being made.

Page 4 of Exhibit 93 is entitled "Additional Capital Expenditures—Auxiliary Engines." Item one is entitled "Install Additional Oil Coolers" and provides for an expenditure of $2,081 in 1939.

The gas engines called the auxiliary engines are used for driving electric generators. There are three of these engines, each of which is a six cylinder vertical engine, with 14¼ inch by 16 inch cylinders. These engines were originally equipped with small oil coolers, which have proven entirely inadequate to properly cool the lubricating oil circulated to the bearings of the engines under normal operating conditions. The temperature of the oil delivered to the bearings may reach 200 degrees Fahrenheit, which is entirely too high for good operation.

It is my judgment that the present operating conditions are entirely too hazardous and that to relieve this situation new oil coolers of correct design to cool the oil to be pumped to the bearings to a temperature in the neighborhood of 120 degrees Fahrenheit must be installed in the year 1939, at a cost of $2,081.

On page 5 of the same exhibit, entitled "Additional Capital Expenditures—Main Engines," are five items.

Item 1 provides for the installation of Cuno filters to replace Nugent oil filters. The Nugent oil filter employs the cloth bag principle, while the Cuno filter consists of a number of thin discs of metal. The work is now being installed at a cost of $1,388.

Item 2 provides for the installation of water wash air filters. Actual experience in several seasons when severe dust storms prevailed has definitely proven that the present type of air filters serving the Worthington gas engines are inadequate, for the reason that this type of filter rapidly becomes overloaded with dust as the dust storm proceeds, resulting in restrictions in the flow of combustion air to the engine cylinders or in a carry-over of dust into the cylinders or in a complete shut-down of the engines.

582 Experience has proven that a water wash type of air cleaner is much more satisfactory and much more efficient, since it not only separates out all of the dust continuously, but also continuously removes and carries away to waste the entrained dust particles, maintaining a con-

stant minimum pressure drop through the filtering system for the passage of air. This work is, in effect, a continuation of a program already instituted at some of the other stations on this pipeline. At other stations water wash air filters have been installed, and it is therefore my judgment that water wash air filters must be installed at the Fritch compressor station in 1939 at a cost of $5,100. At the present time there are fifteen involved, one for each of the engines. There happen to be two filters per engine on the oil filtration, so there are 30 in all.

Item 3 provides for the installation of new type mufflers for the Worthington engines in 1940. A muffler is an enlargement in the exhaust line from a gas engine, designed for the separation of moisture from the exhaust gases, and also for an appreciable degree of silencing of the noise of the engine exhaust. There are two mufflers for each Worthington engine, a total of thirty.

It is our experience that mufflers of this character must be periodically replaced, due to the severe degree of corrosion to which they are subjected by the exhaust gases. It is therefore my judgment that the present exhaust mufflers must be replaced not later than 1940 at a cost of $14,517. That would be two mufflers to each engine, or thirty in all.

Item No. 4 is "Install 2 Unloaders." Unloaders have already been described in the record. An unloader is a volume or chamber which is attached to the compressor head at the end of the cylinder, which by means of a valve, which can be opened, increases the clearance volume at the end of the cylinder, thereby adding to the flexibility with which the compressor can be operated through a range of suction and discharge pressures, without seriously overloading the engine which drives the compressor. It does not extend the piston stroke, but simply extends the chamber at the end of the piston stroke.

Unloaders have heretofore been installed at the Fritch station and at other stations on the pipeline. At the Fritch station ten gas engine driven compressors have been equipped with compressor unloaders, and at the present time it is necessary to operate nine or more of the engines which are equipped with the unloaders continuously. This means that the desired degree of flexibility in operation is not thereby provided; that in the event of one of the engines with unloaders being inoperative for a complete overhauling, all of the remaining engines so equipped must

operate continuously, in order to compress the required volume of gas. We desire to add to the number of units available with unloaders by adding two unloaders to one engine in 1940, at a cost of $834.

Item 5 provides for the installation of Worthington Unit No. 16 in 1946. In the next years, 1940 and 1941, there
583 will be occasions when fourteen engines must be operated for considerable periods of time in order to compress the requisite amount of natural gas. That is increased over past years because of an anticipated decline in suction pressures of certain volumes of gas to be compressed, and that will increase as the years go by and the pressures at the wells become less.

It has been definitely proven, through actual experience, that not less than two spare engines or standby engines must be available at this station at all times in order that all gas engine driven compressors may be kept in proper condition by a prudent maintenance program. Since the operating schedule calls for fourteen compressors, it becomes necessary to add one compressor. This addition has been set for not later than 1946, at which time throughout seven months of the year fourteen engines must be operated continuously.

The installation of this sixteenth unit would be on a concrete foundation which was installed for that purpose in 1935, at the time the last three engines were installed. This installation will be made at a cost of $70,466. In other words, we have had the installation of this engine in contemplation since the concrete base for it was installed in 1935.

The installation of this unit is delayed until 1946 for the reason that during the next two succeeding years the occasions for operating 14 units are not so frequent. However, for the two or three years preceding 1946, fourteen unit operation will be the rule, and the unit could well be installed prior to 1946. However, in the judgment of myself and the chief engineer, the date for installation of this engine was established in 1946.

Page 6 is entitled "Additional Capital Expenditures, Station Piping," and nine items are shown on that page.

Items 1, 2, 3, and 4 refer to additions which have already been made in 1939 to the various pipe systems of the plant.

No. 5 provides for the replacement of certain 12 inch and 18 inch muffler drain lines in the year 1940. This section of piping embraces 638 feet of 12 inch pipe and 230

feet of 18 inch piping, carrying hot water drained from the exhaust mufflers from the 15 gas engines. This hot water is extremely corrosive to these lines. The 12 and 18 inch lines are subjected to severe external and internal corrosion. It is my judgment that this piping must be replaced not later than 1940 at a cost of $4,973.

Item 6 provides for jacketing the 6 inch compressor discharge piping in 1940. The compressed gas is carried from the gas compressor cylinders underground to the near vicinity of the cooling tower, where it emerges from the ground and enters a manifold, and from there passes into the gas coolers in the base of the cooling tower.

The piping which carries this compressed hot gas from the compressor cylinders to the gas coolers is, there-
584 fore, subjected to the high temperatures of the compressed gas, which have been stated. There has not come to our attention any pipe coating which will withstand temperatures in this range for the protection of underground piping. The 6 inch buried compressor discharge piping has, therefore, been subjected to considerable amounts of corrosion, and at the present time we are faced with the problem of either replacing it or applying some form of protection.

The total footage of buried piping to which this item refers, serving the 15 compressors, amounts to 3,493 feet of 6 inch pipe. The prices given are installed prices and include the complete cost of labor and material. That is true of all the other items for additional capital expenditures shown in the exhibit.

In lieu of replacing this corroded pipe, it is proposed to apply to the external surface of the piping before it is completely deteriorated a jacket consisting of a shell of steel approximately ¼ inch thick. This jacket will be welded around the 6 inch pipe and will then protect the 6 inch pipe for a considerable period of time. In order to provide adequate and necessary protection to this hot 6 inch compressor discharge piping, it will be necessary in 1940 to apply a jacket at a cost of $9,492. The gas pressure in this discharge pipe is 740 pounds per square inch gauge.

If the pipe became unduly weakened due to corrosion, the line would readily rupture, and a very serious fire and explosion would almost inevitably follow, and our compressor station would be very, very seriously wrecked. This would have a very marked effect upon the volume of gas available for the markets, due to the fact that this station

could not compress the required volume. As a matter of fact, it could not compress any. If the station burned down, we would be able to get very little gas, if any, into Chicago.

Item 7 provides for the replacement of 6 inch sickle bends. On Exhibit 92 the arrow leading from No. 3 points directly to the row of sickle bends.

Sickle bends are the bent piping through which the compressed gas from the gas compressor cylinder leaves the ground, and through a 180 degree bend enters a continuous header located above the ground level. It is called a sickle bend due to the resemblance of the pipe bend to a common agricultural sickle. It is used for the purpose of an expansion bend and to withstand certain vibration effects.

The sickle bends have been subjected continuously to severe vibrations, due to pulsations transmitted from the compressor cylinders. It is a matter of experience that piping of this nature, subjected for a considerable period of time to severe vibration of this character, eventually becomes weakened and is likely to fail, unless it is replaced. It is my judgment that these sickle bends cannot be operated beyond the year 1945, and that they must be replaced in that year at a cost of $3,713.

Item 8 provides for the installation of anchorages on 585 6 inch discharge lines in 1939. This refers again to the 6 inch piping carrying the hot compressed gas from the gas compressor cylinders to the cooling tower. At the compressor cylinder end of this piping, inside of the main compressor building, there are certain bends by which the piping which is below the floor level connects to the compressor cylinder above the floor level. Due to the nature of the service to which it is subjected, this pipe tends to expand and contract to a considerable degree as the temperature changes from the operating temperature to normal atmospheric temperatures when the engine is inoperative.

In January of this year a compressor piston rod broke in one of the gas compressor cylinders. This failure could have caused a very serious fire and explosion. However, it fortunately did not. The failure of this compressor piston rod is attributed to the movement of the compressor cylinder, due to strains which have been placed upon this gas discharge pipe by the temperatures mentioned.

It is my judgment that this piping must be securely anchored in such a manner as to eliminate all thrust on the pressure cylinders, for the safety of the plant. It is

therefore proposed to install anchorage at the compressor end of this discharge piping in 1939, at a cost of $6,508. There is a total of thirty compressor cylinders, two per engine.

Item 9 provides for the installation of 12 inch headers in 1945. This item covers replacement of certain 12 inch header piping adjacent to the cooling tower from which the hot compressed gas enters the gas cooling sections, and to which the cooled gas returns after passing through the gas coolers.

This header piping is subjected to considerable vibration due to pulsations transmitted from the gas compressor cylinders, and it is a matter of experience that piping of this nature will eventually fail at points where lateral connections are welded to the main section of the header, there having already been several such failures at Fritch. Accordingly, it is my judgment that this header piping must be replaced not later than 1945, at a cost of $4,591.

We have heretofore done some replacing. Between the header and the lateral connection reinforcing plates are installed. There are four usually, installed at 90 degrees around the circumference of the lateral pipe connection. These reinforcing plates are called gusset plates.

A gusset plate is a triangular shaped piece of steel plate, the short sides of the triangular shaped section of the plate being welded, one side to the main connection or header, the other side to the lateral. With four of these plates around the lateral connection it has been considered that satisfactory reinforcement of the assembly was obtained. However, with headers at the Fritch station subject to pressures and vibration conditions which I have described, failures occurred at the toe of the gusset plate, in each instance on the header pipe itself, that is, the larger sized pipe. There was a fracture of the pipe completely through the pipe wall, necessitating complete replacement.

586 There seems to be a concentration of stresses at the point of attachment of the gusset plates to the header and to the lateral, and we have long since abandoned the use of the gusset plate for construction of this nature. The gusset plate has not been satisfactory for service of this character. We use what is known as a saddle reinforcement, which is a forging which completely encircles the lateral and extends out and over the header piping for a considerable distance and which is welded to the header and to the lateral as a reinforcement. These headers are

not the parallelepipeds I spoke about. This is a different form of header constructed of pipe.

Page 7 is entitled "Additional Capital Expenditures, Buildings and Grounds," and twelve items are mentioned there.

Item 1 has already been installed. Item 2 represents construction work which is now in progress.

Item 3 provides for the graveling of the area around the exhaust stacks at the Worthington engine side of the main compressor building. Since the beginning of operations the ground area surrounding the Worthington engine exhaust stacks has presented a very unsightly appearance. Due to the heat from the exhaust muffler, which is below ground level, and to the action of the water spray which is discharged from the exhaust stacks, no vegetation will grow in the area near the exhaust stacks. This results in the formation of a dry, barren stretch of top soil, and this soil becomes easily pulverized and is whipped almost continuously by even the slightest breeze against the compressor building, and in summer and the warm times of the year it results in considerable dust entering the doors, open doors, and open windows of the building.

The exhaust mufflers will be replaced in 1940. Following this operation, it will be necessary to remove this top soil and install a gravel paving surrounding the exhaust stacks to alleviate the condition described.

Item 4 provides for the installation of steel bins in warehouse and tool room in 1940. The storage of spare parts, tools and supplies in the warehouse serving the compressor station and in the tool room in the auxiliary building is carried out on wooden shelves and in wooden bins, which present a very unsightly appearance and are a very great fire hazard. It is my judgment that to eliminate the serious fire hazard from these wooden bins and shelves, it will be necessary in 1940 to replace the wooden bins and shelves with bins and shelves of steel construction, at a cost of $695.

Item 5 provides for the installation of 19 door checks in 1940. The swinging doors of the main and auxiliary buildings at the Fritch compressor station are constructed of heavy metal, and some are equipped also with wire glass panes. The operating force must necessarily pass through these doors many times per day in the performance of their duties. Due to the fact that brisk and heavy winds prevail during a great part of the year, there is an ever present

danger that the wind will whip the door from a man's hand and slam it violently open or shut, either seriously injuring the man or injuring the door or breaking the
587 glass pane. We have had men injured by that condition. Experimental door checks have given satisfactory results, and consequently, it will be necessary, for the protection of the personnel and to avoid further damage to the doors and buildings, to install 19 door checks in 1940, at a cost of $456. It is a larger, heavier piece of equipment than the ordinary type of door check.

Item 6 provides for installing a Transite roof on the main compressor building in 1943. Transite is a corrugated asbestos building covering which is used in lieu of the corrugated galvanized iron in a great many places. The original installation of the main compressor building was made in 1931 with corrugated iron roof and siding upon steel framing. The covering of this building is exposed to the action of the water spray blown from the cooling tower on one side and to the action of the water spray which is discharged from the Worthington engine exhaust stacks on the other side. This water spray contains a high concentration of total solids, and the spray when deposited upon the metal surfaces tends to cause the metal to corrode severely. In addition, under the action of expansion and contraction plus vibration, the corrugated iron covering tends to become loosened, causing an undue amount of leakage, particularly of the roof covering, by which I mean leakage from rain and some dust.

At other stations on this pipeline system the deterioration of the building covering has proceeded to the extent that two buildings had to be re-roofed in 1938, and in addition careful inspection has revealed that new roof coverings must be applied to the remaining buildings in the near future. There is a Transite roof on the laboratory building, and the two buildings above mentioned which were re-roofed in 1938 were re-roofed with Transite in place of the metal roofing. It is my judgment that the metal roof must be replaced with the more permanent Transite roofing in 1943, at a cost of $10,278.

Referring back to page 5, Item 5, "Install Worthington Unit No. 16," that Worthington unit or engine is the same as the main compressor units installed which compress the gas and push it on to its destination.

Item 7 provides for the extending of the main building for Unit 16, which I have just mentioned. This building

must be extended at the time the engine itself is installed, that is, in 1946. At the present time space is available in the main compressor building for this engine No. 16, inasmuch as the concrete foundation is already in place. This building space is absolutely indispensable, however, for the storage of heavy repair parts and for conducting the necessary continuous repairwork to be carried on with a minimum of interference with normal operating activities, and saves much expense which would otherwise be necessary for handling repair parts to and from the more remote storage spaces. At the time the No. 16 Worthington engine is installed in this portion of the building, it will be imperative that this working space and storage space be provided for by extending this main building a distance of 28 feet, at a cost of $8,020.

Item 8 provides for the construction of black top 588 roadway and parking lot. This has reference to a roadway and parking lot which were constructed on this Fritch station site in the year 1936, in conjunction with the construction of an enlarged office building. The parking lot and roadway serving this building were constructed at that time of native materials, native gravel, and these surfaces of the parking lot and roadway have been subjected to serious rutting and erosion and present a considerable dust hazard. In accordance with the practice of providing hard surfacing or black top surfacing for the other plant roadways, these unsurfaced areas will be provided with a black top in 1939, at a cost of $1,831. This involves the use of asphalt and fine gravel.

Item 9 provides for the extension of the auxiliary building a distance of 14 feet in 1940. The purpose of extending the auxiliary building 14 feet as provided under this item is to provide space for the installation of water filtration plant, Item 16, page 3, of this exhibit. This extension will cost $1,740.

Item 10 has been approved and is under construction.

Item 11 provides for the installation of 2 Bay extensions for the pipeline warehouse in 1940. By 2 Bay is meant two section extensions. As previously mentioned, it is my duty to maintain the buildings on this Fritch station site and to install all necessary additions to those buildings. I have been directed by the chief engineer to provide in this statement of additional capital expenditures for this installation for the benefit of the pipeline department.

The auxiliary building is shown on Exhibit 92 but it is not numbered. It is just to the rear of No. 1, the main building.

The same reasons for installation apply with reference to Item 12 as were given for Item 11.

Page 8 of Exhibit 93 is entitled "Book Cost of Property Retired—Dwelling Houses and Facilities," and the words "Retire 163 feet of curbing" are used in two instances, with an amount of $163 in 1939 and $163 in 1940. In carrying out the construction of cottages during the years 1939 and 1940, it will be necessary in each year to extend certain of the existing roadways, and in order to make that extension in each year it will be necessary to destroy existing curbing. The details shown on page 8 represent the book cost of the curbing which will be retired from investment in 1939 and in 1940.

Pages 9 to 12 inclusive show the book cost of certain property retired, page 9 being equipment retired, page 10 being certain portions of the main engines retired, page 11 being certain station piping retired, and page 12 being certain buildings or portions thereof retired. Those items are retired on account of their replacement by certain items to which I have already testified.

On pages 9 to 12 inclusive, the word "salvage" is shown at the bottom of each page. For instance, on page 9, there is an item under the subheading "Salvage" entitled "Reclaimed Calorimeter," with an amount of $200 under
589 the year 1944. That is the salvage value of the calorimeter which will be retired on account of the purchase of the calorimeter referred to on page 3, line 21, of Exhibit 93. By the use of the word "salvage" in connection with this item I have reference to the fact that, in my judgment, at the time the present Thomas calorimeter is replaced with a new calorimeter we will obtain from the manufacturer $200 credit for the return of the worn out equipment.

On page 12 there is another salvage item, which represents the book value of the usable equipment retired from investment, and that is with reference to the overhead telephone service referred to on page 7, line 10, of the exhibit.

The retirement of the corrugated roof is a part of the installation of the Transite roof on the main building. We retire from investment the book cost of the existing corrugated iron roof covering. The dustop air filters on page 10 are being replaced by the water wash air filters

on page 5. The retirement of the 3 inch underground air line on page 11 correlates with the work which has already been completed on page 6, line 3, Item 3.

Page 13 and several subsequent pages are with reference to the additional capital expenditures of the gasoline plant, and the page is headed "Additional Capital Expenditures and Book Cost of Property Retired." The first line, "Equipment" is further explained on page 15 of the exhibit, and the second and third lines entitled "Station Piping" and "Buildings and Grounds" are further explained on pages 16 and 17 of the exhibit; and under the subheading "Book Cost of Property Retired," lines 5, 6 and 7 are further explained by pages 18, 19 and 20 of Exhibit 93, and lines 9, 10 and 11 under the subheading "Salvage" are also explained in more detail on pages 18, 19 and 20 of the exhibit.

On page 14 additional capital expenditures and book cost of property retired are shown for laboratory apparatus. The expenditures set out under that item for the year 1939 have already been completed. In my judgment it will be necessary to make small expenditures each year for the replacement of worn out laboratory apparatus and for the purchase of new apparatus.

Page 15 is entitled "Fritch Gasoline Plant, Additional Capital Expenditures, Equipment," and shows eleven items, explained as follows:

Items 1 and 2 have been installed. The work provided for under Item 3 has been approved and preparations are under way to effect this installation. Item 4 has been completed.

The construction provided under Item 5 has been approved for completion.

By approval, I mean a work request has been signed and authorized by the management for the expenditure immediately, and drawings are being prepared and material being ordered.

590 Item 6 has been approved and authorized.

Item 7 provides for the installation of a gas fired oil preheater. In the operation of the gasoline plant it has been found necessary to install and operate equipment for cleaning or reclaiming the absorption oil used in the process of absorbing natural gasoline from the natural gas. This oil becomes contaminated from various sources and the function of the reclaimer is to rid the oil of the

contaminating materials, which include lubricating oil from the gas compressors, gummy material, and carbon or coke. The capacity of the present oil reclaimer is inadequate to maintain the desired condition of the absorption oil, and in order that this equipment may be caused to render satisfactory service a gas fired heater unit must be provided to replace the present steam heater equipment. It is my judgment that this equipment must be installed in 1939 at a cost of $1,125.

The next item is "Install 144 foot Cooling Tower," with an expenditure of $14,400 in 1948. The necessity for that expenditure is the same as the explanation I gave for the erection of a 180 foot cooling tower referred to on page 3, Item 25, of Exhibit 93.

Item 9 provides for the installation of air filtration equipment in the pump and recompressor building and in the boiler house at the gasoline plant. This installation is identical with that provided for on page 3, Item 28, and is properly called dust protection equipment. My explanation for the necessity of that item is the same as for the one to which I have just referred.

Item 10 provides for the installation of cooler, accumulator and pump in 1939. This installation has been authorized, and work on the installation is under way.

Item 11 provides for the purchase of miscellaneous tools and provides an allowance of $50 per year for the years 1940 to 1951 inclusive, for the same reasons as outlined under Item 29, page 3.

Item 12 has been completed and the purchase has been made.

Item 13 provides for the purchase of miscellaneous laboratory equipment in the amount of $50 per year during the years 1940 through 1951. In the operation of a general chemical laboratory it is necessary from time to time to replace worn out and broken apparatus and to purchase apparatus for new work or for special problems. It is my judgment that this allowance will be necessary in order to properly carry out the functions of this laboratory.

Page 16 is entitled "Fritch Gasoline Plant, Additional Capital Expenditures—Station Piping," and shows four items.

Item 1 has been authorized and the work is under way.

Item 2 provides for the laying of 548 feet of 4 inch pipe. This item covers the replacement of 548 feet of 4 inch pipe

which serves to carry hot compressed gas from some of
591 the gas compressors at the gasoline plant to the outlet from the gasoline plant. This pipeline operates at a high temperature and carries gas at a pressure of approximately 740 pounds and is subject to serious corrosion. It is my judgment that this pipe must be replaced in 1940, at a cost of $512.

Again, in 1947, under Item 3, it is my judgment that this pipe will have to be replaced, at a cost of $512. This is the same pipe, for a similar purpose.

Item 4 provides for the construction of vapor recovery and steam lines. A vapor recovery line is a system of piping installed on the loading rack to be used for the entrapment of the vapor ordinarily evolved in the loading of gasoline into a tank car through an open dome cover. At the present time one-half of our gasoline output is being marketed in tank cars. However, it is probable that beginning in 1940 our entire output will be so marketed.

The loading of gasoline into an open dome of a tank car is an extremely hazardous operation. The purpose of the vapor recovery system will be to provide piping and appliances by which the gasoline can be loaded into the tank car and the vapor evolved can be withdrawn through a safe system of piping to an appropriate safe place, in such a manner as to eliminate the hazard existing in loading through the open dome. An accidental spark nearby the loading place would cause a fire, and has in other operations. We have not had any fires yet.

I have said that half of our gasoline is shipped by tank car now. The other half is delivered to the purchaser through a pipeline, and it is the purchaser's pipeline. They come to the station after the gasoline.

In addition to the hazard of loading tank cars, which is to be corrected by the addition of the vapor recovery line, it will be necessary to provide a steam line to the loading rack, to be used for the purpose of steaming out the tank cars prior to entering them for the purpose of making repairs. It is becoming more and more necessary to enter the tank cars for the purpose of freeing the outlet valves, and this is an extremely hazardous undertaking with the present equipment. At the time the vapor recovery system is installed, it is my judgment that a steam line should be provided for the general safety of loading operations. This work should be performed in 1940, at a cost of $2,996.

Page 17 is entitled "Fritch Gasoline Plant, Additional

Capital Expenditures—Building and Grounds," and shows four items.

Item 1 has been authorized and work is under way.

Item 2 provides for the installation of fourteen door checks in 1940. The explanation for the necessity of those fourteen door checks is the same as Item 5 on page 7, to which I have already testified.

Item 3 provides for extending sidewalks at the gasoline plant in 1940. Originally, some gravel sidewalks were provided for the use of the operators in passing from
592 the cottage area to the gasoline plant area, and from the gasoline plant area to the compressor station. These sidewalks, gravel walks, have long since been covered by blown dust, and it is necessary that firm footing be provided for those men who must pass through these areas. It is therefore my judgment that a concrete sidewalk should be constructed from the compressor station to the gasoline plant and from the gasoline plant to the cottage area in 1940, at a cost of $979.

Item 4 has been authorized and the work is under way.

Pages 18, 19 and 20 of this exhibit refer to book cost of property retired and to salvage. My explanation of the book cost of property retired and salvage with reference to the Fritch gasoline plant and of the way this exhibit is set up is the same as my explanation with reference to the compressor station.

The Mason pump governors on page 18, line 4 relate to the 10 pump governors in line 4, page 15.

My attention is called to page 18, Item 1, reading "Retire top of 1600 barrel tank," with an expenditure of $100 in 1939. Early this year the top of the 1600 barrel tank was completely destroyed by a wind storm. It was accordingly retired from investment.

Item 2 on the same page, being an expenditure of $1,684 in 1939, represents the book cost of two 1600 barrel wood water tanks which have been retired from gasoline plant equipment. They have been reinstalled as a portion of the compressor station investment, Item 4, page 3, of this same exhibit.

Item 12, "Retire Fisher Titrimeter," with an amount of $194 in 1939, represents the book cost of an item of laboratory apparatus which has been retired from investment.

On page 19, entitled "Book Cost of Property Retired—Station Piping," Item 2, reading "Retire 2 inch oil line," represents the book cost of a certain section of 2 inch oil

line which has been retired from gasoline plant investment and reinstalled as a portion of the additional capital expenditure shown under Item 1, page 6. The oil line was used as a portion of an addition to the yard hydrant system. The salvage of 1018 feet of 2 inch oil line, at the bottom of page 19, refers to Item 2 on the same page.

On page 19 there is a retirement of 545 feet of 4 inch pipe in 1940 at $291, and the same amount of 4 inch pipe in 1947 at $512. The book cost of the existing 4 inch line amounts to $291. That is the amount now on the books against that particular section of piping. In 1947 the book cost of the property retired will be equal to the additional capital expenditure shown under Item 2, page 16, in the amount of $512. In other words, the cost of laying 548 feet of 4 inch pipe in 1940, with prices as of June, 1939, is higher than the cost of the same equipment in 1930 and 1931, and in addition, the conditions under which the 593 replacement must be made are much more difficult, due to the conditions of operation of the plant and the adjacent pipelines and other structures.

Page 21 is entitled "Refrigeration Plant, Additional Capital Expenditures and Book Cost of Property Retired." Under the heading "Additional Capital Expenditures" the first three lines, "Equipment," "Station Piping," and "Building and Grounds," are explained more in detail on pages 22, 23 and 24, respectively, of this exhibit 93; and under the subheading "Book Cost of Property Retired," lines 5, 6 and 7, entitled "Equipment," "Station Piping," and "Buildings and Grounds," are explained more in detail on pages 25 and 26, with the exception that there is no property retired for Buildings and Grounds, being line 7.

Referring to Item 2 on page 16, this should be "Lay 545 feet" instead of 548 feet. 545 is the correct figure in all places where this line is referred to.

In 1947 we are going to retire pipe which will be laid in 1940.

Page 22 is entitled "Fritch Refrigeration Plant, Additional Capital Expenditure—Equipment," and mentions three items.

Item 1 has been completed.

Item 2 provides for the installation of 7 G. R. Bentube Coolers in 1948. This refers to Item 26 on page 3. This item on page 22 refers to the replacement of 7 coolers serving the dehydration plant, which, in my judgment, will have deteriorated to such an extent that they must be

replaced not later than 1948 at a cost of $5,192. It is the same kind of equipment as that referred to in Item 26, page 3. In other words, the item on page 3 refers to the compressor station, and the item on page 22 refers to the refrigeration plant.

Item 3 provides for remodeling the refrigeration plant in the year 1942. This equipment is not now operating as it was originally intended to be operated, for the reason that very shortly after it was placed in operation as originally intended, the troubles and difficulties with gas hydrate formations immediately became apparent. It was necessary to modify the plan for operating this equipment until the problem could be solved and some means be provided for the prevention of the difficulties due to the hydrate formations.

The solution arrived at was the injection of calcium chloride brine solution into the exchangers and into the propane-to-gas exchanger serving this facility. The function of the liquid brine was to wet the surfaces of the heat exchangers in such a manner as to prevent the formation of hydrate crystals. Due to the nature of the construction of the exchangers into which the brine is injected, it is extremely doubtful that the brine reaches all portions of the heat exchanger surface. Consequently it has been found that a certain amount of gas hydrate builds upon the heat exchanger surfaces at a very slow rate.

594 Had we originally contemplated the use of this liquid in this process, we would have utilized an entirely different design, employing a contractor or large tank containing trays or bubble plates, by means of which we would have contacted the gas with this hydrate inhibitor, and a great deal more attention and care would have been exercised in the selection and design of the facilities for separating moisture from the gas stream.

Originally the process was a straight refrigeration process, in which the gas to be dehydrated was to be cooled to a temperature of 40 degrees Fahrenheit, at which the water vapor contained in the gas would condense to such extent that nowhere else in the operation of our transmission system would pressure and temperature conditions prevail at which additional moisture could condense out of the gas.

The refrigeration process then was expected to separate from out of the gas the desired amount of water vapor. However, in the operations with the injection of the brine

inhibitor it has been found that occasionally through some disturbance in the gas flow or otherwise, a small amount of the brine may pass out of the dehydrating equipment into the main line. This is extremely undesirable, and a hazardous condition. We also find that there is a certain amount of corrosion occurring, due to the use of the brine solution.

I have stated that brine may pass out of the refrigerating system into the pipeline. It has actually passed out. A certain amount of corrosion is occurring in the metal parts contacted by the brine. The evaporating equipment utilized in reconcentrating the brine is particularly susceptible to this corrosion, and numerous replacements of heating coils have been made. Some corrosion is also occurring in the dehydration equipment which is exposed to the main gas line pressure, which at this point varies between 735 and 715 pounds per square inch gauge.

This corrosion, due to the action of the calcium chloride brine, has not proceeded to a dangerous extent. However, it is my judgment that the use of this brine should not be continued beyond the year 1942, and that some other fluid to be used for this purpose should be found.

It is also my judgment that at the time we select some other fluid, of which there are several now available which will perform the same function as calcium chloride brine and which are non-corrosive, the plant should be remodeled in such a manner as to positively guarantee against the extremely slow hydrate formation which now takes place, and against any possibility of any carry-over of fluid into the main line, and to provide complete contacting between the gas and the inhibitor. Several dehydrating plants have been installed in recent years on other pipelines of various designs, and utilizing various inhibitors.

This brine fluid enters the pipeline as a fluid. However, the passage of the dry gas through the pipeline in contact with any brine fluid which may be found results in that gas picking up and absorbing the moisture content in the brine solution and eventually leaving the brine as a crystalline deposit. That is a matter of experience that we
595 have found in the pipeline. We have not observed so far that it ruins the pipeline. The formation of these crystals inside of the pipeline in time would doubtless result in decreased flow efficiency of the gas through that particular section of the pipeline so affected.

Over a period of years the brine which enters the pipeline is a very small amount, a few barrels; but it could be

much more than that in the event of some failure of equipment. There are other styles and designs of dehydration equipment now in operation on other pipelines, and it is my intention to submit designs and plans for remodeling this equipment to take advantage of all the improvements incorporated in recent designs, if at all possible. Accordingly, it is my judgment that, not later than 1942, the dehydration equipment must be remodeled at a cost of $90,251. It is my judgment that such expenditures will be approved when presented to the management.

Page 23 is entitled "Fritch Refrigeration Plant, Additional Capital Expenditures—Station Piping," and shows two items of expenditure. (Objection by counsel for Illinois Commerce Commission to testimony with respect to any item beyond the year 1941 upon the ground that expenditures made by the company from the years 1941 to 1954 are not material to the issues involved. Objection overruled.)

Item 1 provides for the replacement of 160 feet of 6 inch pipe in the year 1941. This section of piping is used for the purpose of carrying hot compressed gas and is subject to serious corrosion to such an extent that it is my judgment that it must be replaced in 1941 at a cost of $279. This pipe conveys compressed propane gas from the gas engine driven compressors serving the dehydration plant to the cooling sections in the base of the gasoline plant cooling tower.

The explanation I have given for Item 1 applies also to Item 2. It is my judgment that this line will again have corroded to such an extent in 1948 that it will have to be replaced. It is the same piece of pipe that is to be laid in 1941.

Page 24, entitled, "Additional Capital Expenditures, Buildings and Grounds," contains an item entitled "Install two door checks." This item provides for the installation of two door checks on the refrigeration plant control building, and the explanation of the necessity for that item is the same as the necessity for the door checks to which I referred this morning.

The retirement items on pages 25 and 26, entitled "Fritch Refrigeration Plant, Book Cost of Property Retired, Equipment," on page 25, and "Station Piping," on page 26, are explained in the same manner with reference to the additional capital expenditures of the Fritch refrigeration plant as I have heretofore explained with reference to the

compressor station and gasoline plant. On page 25 the retirement of 7 G. R. Bentube coolers, involving $5,215, is the item referred to on page 22, line 2; and the items on page 26 are the items referred to on page 23, lines 1 and 2.

I prepared this exhibit, and it represents my best judgment of the expenditures which will be made for additional capital expenditures, and the dates thereon represent my best judgment as to the years in which the capital expenditures will be incurred. It is quite likely that some of
596 the expenditures may be necessary prior to the dates shown.

I prepared the figures representing these capital expenditures, using prices as of June, 1939, obtained from the chief engineer. My work sheets used in preparing this exhibit will be available to counsel for the two Commissions, and their engineers, at such time as may be convenient to both of us.

(At this point counsel for defendants offered EXHIBIT 93, which was received in evidence over the objections of counsel for each of the Commissions, to whom an exception was allowed. Motion by Commission counsel to strike all of witness' testimony except such as deals with the reasonably immediate future denied.

Counsel for defendants then presented a document entitled "Texoma Natural Gas Company, Operation and Maintenance, Compressor Station, Gasoline Plant, Refrigeration Plant, Witness R. T. Powers." At the direction of the Examiner, the document was marked Exhibit 94 for identification.)

The first page of Exhibit 94 is entitled "Summary of Operation and Maintenance, Compressor Station, Gasoline Plant and Refrigeration Plant," below which is line 1, entitled "Compressor Station," line 2, entitled "Gasoline Plant," and line 3, entitled "Refrigeration Plant." These are explained in more detail on pages numbered 1, 14, 21-A, respectively, of the exhibit; and under the subhead "Maintenance," lines 5, 6 and 7 are explained more in detail on pages numbered 1, 14 and 21-A of the exhibit.

The next subheading is entitled "Total Operation and Maintenance." The totals shown in the four lines numbered 9, 10, 11 and 12 are the totals respectively of the items above. In other words, line 12 is the total of line 4 and line 8; and line 9 is the total of lines 1 and 5, etc.

On that same page the amounts listed for the years 1932 to 1938, inclusive, are the actual costs of operation and

maintenance of the compressor station and gasoline plant and refrigeration plant for the years indicated; and the next column after 1938 is the average of the years 1936, 1937 and 1938.

Out at the end of those columns, the first from the end is, as is designated, the average for the years 1939 to 1954, inclusive, and the last column is the total expenditures for the years 1932 to 1954, inclusive.

On page 1 of Exhibit 94, lines 1, 2, 4 and 5 are explained in more detail on pages 2, 3, 4 and 5, respectively, of the exhibit. Line 3 is entitled "Traveling Expense," and this item includes necessary traveling expense of officials and engineers whose headquarters are in the Chicago office on behalf of the Fritch compressor station.

Line 6 is entitled "Credits" with the letter "R" before each of the figures shown on that line. The electric generating equipment serving both the compressor station and the gasoline plant is located in the auxiliary building at the compressor station. The amount of electric power
597 consumed by the gasoline plant is metered and a charge is made to the gasoline plant for the amount of power consumed. The credit received by the compressor station for this sale of power is shown under line 6, and the corresponding charge is included in the gasoline plant expense. That is in effect a wash-out so far as Texoma Natural Gas Company is concerned, and is only a charge and credit as between departments for the purpose of keeping account of the cost of operations of the separate units of the plant.

Under the subheading "Maintenance" on page 1, lines 8 to 15, inclusive, are referred to and explained more fully on pages 6 to 13, inclusive, of this exhibit.

Referring to page 1, line 1, entitled "Labor," the explanation of the method of determining the costs involved is shown in detail on page 2; and on page 2 I have computed the total wages per hour for operating shift labor in 1939 with a total of eight employees at a total cost of $5.65 plus per hour. In calculating the operating shift labor for the years 1940 to 1952, a change has been made over the year 1939. Beginning in 1940 and continuing through 1952, it will be necessary to maintain on shift duty 9 men instead of 8, for the reason that the number of gas compressor engines to be operated will be such that additional attendants will be required. (Objection by counsel for Illinois Commerce Commission overruled.)

About the middle of page 3 are the words "Use of Aver-

age Cost per M.H.P. Hr." M.H.P. Hr. means thousand horse power hours, and that has the same reference to the few lines above that to the right where the words occur, "Cost Per M. Horse Power Hour."

At the bottom of the page is a tabulation from 1939 to 1954, and under the heading "Engine Hours" appears a figure, 104,221, and under "Horse Power Hours," 119,514,211. As the years progress that amount increases down to the year 1947 and continues at the rate of 115,272 engine hours, and 130,249,944 horse power hours, down to 1952, when the number of engine hours and horse power hours decreases. The reason for these changes is that the suction pressure at which the portion of the gas to be compressed by the Fritch compressor station will reach the station will decline continuously until the year 1947. As the suction pressure declines, the horse power to compress a unit volume of gas will increase and the quantity of gas compressed per engine will decrease.

For this reason the engine hours necessary to operate in order to compress the requisite volume of gas will increase until 1947, and correspondingly the horse power hours to be expended to compress the gas will also increase. From 1947 through 1951 the volume of gas to be compressed will remain constant, as will the pressures at which the gas will be delivered to the compressor station. Accordingly, the engine hours and horse power hours remain constant. Beginning in 1952 and continuing through 1954, the decline in engine hours and in horse power hours is occasioned through the decline in gas volumes to be compressed, due to the falling off of gas available to the Fritch compressor station in the last three years of operation.

I secured the figures for the quantities of gas which 598 would be put through and compressed at the Fritch compressor station from Mr. R. M. Bussard, who has testified and who will later testify in this proceeding concerning those items.

On page 6 the amounts set out opposite each of the items and under the years in question represent my best judgment as to the cost of labor that will be expended on the maintenance of the equipment of the compressor station. The same is true as to the amounts to be expended on material going into the equipment of the compressor station shown on page 7, and the amounts as to the labor going into the maintenance of the auxiliary engines shown on page 8.

Page 9 shows the cost of materials going into the maintenance of the auxiliary engines at the compressor station; page 10, the cost of labor going into the maintenance of the main engine at the compressor station; page 11, the cost of materials going into the maintenance of the main engine at the compressor station; page 12, the cost of labor and material going into the maintenance of the station piping at the compressor station; and page 13, the cost of labor and material going into the maintenance of buildings and grounds of the compressor station.

My attention is called to page 14 of Exhibit 94, entitled "Fritch Gasoline Plant, Operation and Maintenance," and I am asked to explain how I arrived at the cost of labor going into the operation of the Fritch gasoline plant. The cost of labor, as shown on line 1, is arrived at in a manner similar to that employed in the computation shown on page 2 of this exhibit. On page 2 I show for the compressor station the number of men operating shift labor in 1939 and an increase of one man after 1939. I did not mean to imply that we increased the personnel at the gasoline plant. My calculation, as stated, is similar in principle to that for the compressor station. The smaller number of men required for the operation of the equipment renders it somewhat easier to utilize the plan of totaling the annual salaries of the different operators. For the cost of men on salaries I used the present salary scale and the present hours of employment per man.

All through this exhibit I have used the present rates of pay for all labor and men employed on salaries, and the same hourly time per day. I made no provision for increases in salaries in the future. The first line, entitled "Labor," shows an average of $33,345 per year for 1936 to 1938, and a cost during 1938 of $34,303.08 for this item; but I have used a straight figure of $34,037 thereafter, with slight decreases in the last few years of operation, which indicates that I do not anticipate any increase over the 1938 cost.

To the cost of materials going into the operation of the Fritch plant are charged various materials, including water purchased, electric power, water treating chemicals, gasoline treating chemicals, automobile expense, brooms, charts, cleaning and polishing material, belts, etc. The cost as shown on line 2, page 14, is built up by totaling the cost of the electricity, water, gasoline treating chemicals and miscellaneous materials based upon past experience and nor-

mal consumption of those materials and on present prices.

Throughout this exhibit the present cost of labor and
599 materials was used.

Cross-Examination Interposed by Mr. Slaff.

It is my judgment that prices of material will increase. I have not attempted to study the question deeply enough to form a judgment as to the amount of increase. I have been told to figure material costs on present prices; but I have a generalized judgment that from 1939 on, the prices of material will increase. That applies to everything in this exhibit and my preceding exhibit as far as materials are concerned.

(Motion by Commission Counsel to strike foregoing exhibits on ground of incompetency of witness' judgment denied.)

Direct Examination by Mr. Hedrick (Resumed).

I was instructed to use the present prices as to labor, equipment, etc., in preparing Exhibits 93 and 94, and I did so. I used the prices as of June, 1939.

(Renewal of motion of Commission Counsel and objection to any discussion of Exhibit 94 denied and overruled.)

Line 2 of the exhibit indicates that I expect a slight increase in the expenses for material going into the operation of the gasoline plant over the cost in 1938. I have a gradual increase beginning in 1939. With reference to the cost in 1938 of $60,855.63, the cost in the first four years thereafter, including 1939, will be slightly lower than that cost, and then there will be a slight increase in the future.

Line 3 refers to damages in connection with liabilities incurred through damage to personal and real property of others resulting from the flow of waste water or waste oil across property or a flow of sewage across a property, and it is my judgment that the cost of those items will not exceed $35 a year during the subsequent years of the life of this project.

The cost of operating fuel for the operation of the Fritch gasoline plant, being line 5, is arrived at in this way: Based upon a normal rate of fuel consumption, the boilers will consume a volume of 229,047,000 cubic feet of gas in 1939. In Exhibit 93, page 15, Item 10, allowance has been

made for the installation of certain equipment and the installation of this equipment has been authorized. As the result of placing this equipment in operation, the present supply of fuel now consumed by the boilers will be devoted to other uses and it will be necessary for the boilers to be fired with natural gas instead of the present high BTU value gas. This results in an increased volume of boiler fuel. The remaining item represents the volume of fuel consumed by the gas compressors serving the gasoline plant.

It is my judgment that the cost of lubricating oil and grease going into the operation of the Fritch gasoline plant will be lower during subsequent years than it was in 1938 because of improved economy in the consumption of lubricating oil. There will be a reduction in the quantity used.

Referring to line 7, "Absorption Medium", it is my judgment that the cost of the absorption medium at the Fritch gasoline plant will be only slightly higher in subsequent years than in 1938, and less than the 1936 to 1938, inclusive, average. The consumption reported in 1936 is 600 slightly above normal due to some mechanical difficulties. The absorption oil consumption for 1937 and 1938 is considered to be normal, and is based upon the average consumption of absorption oil during those years per million cubic feet of gas processed. It is a matter of experience that the amount of absorption oil consumed is directly related to the quantity of gas processed, assuming normal operation.

The item on line 8, "Laboratory Expense," includes salaries of four employees engaged in chemical work at the laboratory, plus the cost of materials, chemicals, apparatus, instruments, etc., employed in the conduct of the chemical testing work. The expenditure from 1939 during the balance of the project is slightly in excess of what it was in 1938 because of some salary differences which have been effected and which were in effect June 1, 1939.

The items on lines 11 to 16 on page 14 are explained in more detail on pages 15 to 20 of Exhibit 94.

Page 21-A is entitled "Fritch Refrigeration Plant, Operation and Maintenance." Line 1 on that page is entitled "Labor." It is my judgment that the costs for labor going into the operation of the refrigerating plant will be slightly less in 1939 and subsequent years of this project than they were in 1938. The item "Labor" for the years 1939 through

1952, inclusive, was obtained through a calculation similar to the one described as being used in obtaining the labor under line 1, page 14, for the gasoline plant. The calculation covers the necessary labor and reflects a small economy in the consumption of labor in the operation of the refrigeration plant.

It is my judgment that the expenditures for the years 1939 on for material going into the operation of the Fritch refrigeration plant, as shown on line 2, page 21-A, will be approximately the same as in 1938.

Line 3, entitled "Operating Fuel," shows a slight increase for the years 1939 on, over the year 1938. In preparing a statement to show the fuel consumption of the Fritch refrigeration plant, the increased fuel consumption reflects the increased amount of operation necessary to process the volume of gas in 1939, and thereafter, in excess of that processed in 1938.

On line 4, entitled "Lubricating Oil and Grease," there is an increase over 1938 and a decrease under the average for 1936 to 1938. The increase over 1938 is due to certain accounting procedure in that the actual consumption of oil in 1938 may not have been correctly accounted for. The cost for the years 1939 and thereafter is considered normal, and reflects certain economies in the quantities of oil consumed as compared to the average for 1936, 1937 and 1938.

On practically all of the pages of this exhibit there is a rapid falling off shown in the last two or three years of the expenditures for the operation and maintenance of the compressor station, the gasoline plant and the refrigeration plant. That rapid decrease in expenditures in those last three years is due to the fact that operation and main-
601 tenance expenses will decline in those last three years because of the decreased quantity of gas made available to Fritch for compression.

Referring to the sub-title "Maintenance" on page 21-A, the items opposite lines 6 to 11 are explained in more detail on page 21 for equipment labor and equipment material, page 22 for auxiliary engine labor and material, page 23 for station piping, and page 24 for buildings and grounds.

On page 25 of Exhibit 94, entitled "Compressor Station Department, Maintenance of Houses and Facilities—Fritch," there is shown the cost of maintenance of houses and facilities; and on page 26 is shown the maintenance

of houses and facilities of the production and pipeline department at Dumas, Kingsmill and Skellytown. These maintenance costs are based upon the number of houses now at the Fritch station and upon the schedule for the construction of additional housing facilities. Items 1 to 16, inclusive, on page 25 have been prepared to show the details of the expenses of maintaining the houses and facilities listed, based on past history and experience, and on prices as of June 1, 1939.

It is necessary to maintain the houses by periodic applications of paint in order to preserve the interior and exterior surfaces from deterioration. It is a matter of experience that these houses must be painted every four years. The expenditures shown on pages 25 and 26 are the normal and necessary maintenance and upkeep expenses of those houses and facilities.

Referring to Exhibit 94 as a whole, the prices for labor, material and other items going into the maintenance and operation of the compressor station, gasoline plant and refrigeration plant shown in this exhibit represent my considered judgment, based on experience which I have had during my employment with Texoma Natural Gas Company and experience which I gained prior to that time with other employers, using prices as of June 1, 1939, as to the costs of maintenance and operation of the compressor station, gasoline plant and refrigeration plant during the years shown by the exhibit. I am not testifying as to the continuing of June prices in the future. The costs to which I have testified are over-all costs based simply on unit prices as of June 1, 1939, and I am making no prognostication that these June prices may be effective in the future. (Objections and motions to strike by Commission Counsel and Counsel to the Illinois Commerce Commission with respect to Exhibit No. 94 and the testimony in explanation thereof overruled and denied.)

Exhibit 94 was prepared by me. It is my work. It is my judgment that these items of labor and material referred to in this exhibit will be required in the future operation and maintenance of the compressor station, gasoline plant and refrigeration plant during the years in question.

(At this point counsel for defendants offered EXHIBIT 94, and it was received in evidence over the objec-

tion of counsel for each of the Commissions, to whom an exception was allowed.)

Cross-Examinatoin by Mr. Slaff.

I have testified in no other cases and have written no technical papers other than the one to which I referred in my testimony. My working papers will be down at Fritch.

602 W. H. DAVIDSON, a witness for defendants, testified as follows:

Direct Examination by Mr. Hedrick.

(July 28, 1939.)

My name is W. H. Davidson. I reside at 2218 Ewing Avenue, Evanston, Illinois, and am 37 years of age.

I attended Texas A. & M. College and received the degree of Bachelor of Science in civil engineering in 1924.

Immediately after graduation I was employed by the Empire Companies in Bartlesville, Oklahoma, as junior engineer, and as such I secured field experience in the oil production, refining and engineering departments. I also had varied experience in the various departments of the office of that company in Bartlesville, Oklahoma.

After a year as a junior engineer I was assigned permanently to the engineering and construction department. In 1925 I was detailed as assistant resident engineer on the construction and revision of the gas compressor station located at Petrolia, Kansas, for the Empire Gas & Fuel Company. Later in that year I was assigned to Ponca City, Oklahoma, where I was engaged in construction work at the Empire refinery there. In 1926 I was assigned to several construction jobs, consisting of small compressor stations. Later in that year I was on a job which entailed a continuation of the construction program at Petrolia, Kansas, where I had been the year before.

As stated, I assisted in the construction and revision of a compressor station at Petrolia, Kansas. I was assigned to that point on three different occasions to carry

out the planned construction program. In 1927 I was assigned as resident engineer on the construction of the compressor station at Pampa, Texas, which was situated on the gas line leading from the Texas Panhandle to Wichita, Kansas. While at that point I was also assigned as resident engineer on the construction of a carbon black plant. In 1928 I was detailed as resident engineer on the construction of a new compressor station at Corwin, Kansas.

I said I was resident engineer. The Empire Company of Bartlesville, Oklahoma, maintained an engineering and construction department. One of the functions of this department was to design and to construct various plants for all of the departments of that company. The department had a number of construction engineers who were assigned to jobs in the field as they came up. As resident engineer on such a job I had responsible charge of an individual plant, which included the supervision of the erection and installation as well as of personnel required in making such erection and installation.

In 1929 I spent several months at the Tallant, Oklahoma, compressor station, engaged in the revision of
603 that station, the installation of new equipment, and the revamping of the gasoline plant at that point. About April of 1929 I was assigned to East Chicago, Indiana, as assistant resident engineer on the construction of a 15,000 barrel refinery. The plant was originally designed as a 15,000 barrel plant. Early in 1930 an additional 10,000 barrel extension was added. The approximate cost of the entire plant was $13,000,000. The construction of that project was completed late in the year 1930. After its completion I returned to Bartlesville, Oklahoma, where I spent several months in the office writing a report on the construction of that plant.

In March, 1931, I transferred to the Continental Construction Corporation, where I was assigned as resident engineer of the construction of what is now known as No. 9 compressor station of Natural Gas Pipeline Company, at Harper, Iowa. I spent only a short time at that point, and then moved to No. 10 station, near Geneseo, Illinois, and started the construction of that plant. At midyear I was transferred to the pipeline department to supervise the construction and completion of the pipeline throughout the state of Illinois.

When the Natural Gas Pipeline Company started operations as such in 1931, I was given the position of district pipeline superintendent, having as my territory the state of Illinois. I continued in that capacity until June, 1934, when I was transferred to the Chicago office and given the responsibility of superintendent of compressor stations for Natural Gas Pipeline Company, and that is my title at this time. I have supervision over the nine compressor stations of Natural Gas Pipeline Company.

(At this point counsel for defendants presented a document described as "Natural Gas Pipeline Company and Texoma Natural Gas Company Compressor Stations." At the direction of the Examiner, the document was marked Exhibit 95 for identification.)

Exhibit 95 is a map showing the route of the pipe line from the Texas Panhandle field to Chicago, and at intervals thereon are shown the several compressor stations which operate on this pipe line. The compressor stations are marked on the map. Station No. 1 at the south end of the line is the station over which Mr. Powers, who testified yesterday, is general superintendent. My territory starts in at Station No. 2, about an inch up on the dark line north of Station No. 1.

Station No. 2 is located at Gray, Oklahoma. The number of engines installed at each plant and the horse power of the engines and the total installed horse power is shown at each point marked "Compressor Station." The approximate distance in miles between Stations 2 and 3 is 84; between stations 3 and 4, 84; between Stations 4 and 5, 89; between Stations 5 and 6, 86; between Stations 6 and 7, 90; between Stations 7 and 8, 89; between Stations 8 and 9, 91; between Stations 9 and 10, 99; and between Station 10 and Joliet, 109.

In addition to the stations being numbered on Exhibit 95 they are also designated by name, such as Gray, Minneola, Heizer, etc., and are sometimes referred to by name instead of number.

604 (At this point counsel for defendants offered Exhibit 95, and it was received in evidence without objection.

Counsel for defendants at this point presented a document described as "Fairchild Aerial Survey, Inc., Dallas, Texas," and on the reverse side, "No. 303405-2, Com-

pressor Station No. 6, Continental Construction Corporation, near Beatrice, Nebraska." At the direction of the Examiner, the document was marked Exhibit 96 for identification.)

This picture was taken quite soon after the completion of that station in 1931. It is an aerial photograph of the compressor station numbered 6, located near Beatrice, Nebraska, and shows the general lay-out employed at all of the compressor stations on the main pipeline. On this picture are shown numbers from 1 to 17.

The structure or building designated as No. 1 is what is called the main compressor building and houses the main compressor units. The figure 2 points to the exhaust stacks and mufflers which serve the main compressor units. Figure 3 is the auxiliary building which houses the generating equipment, pumps, machine shop, boiler, and other pieces of equipment. Figure 4 shows the office building. Figure 5 shows a building which is utilized as a combination warehouse and garage. Close by to figure 6 is what is known as the 30 by 30 sump.

A sump is a facility which could be called a hot well, and is used to receive the cooling water as drained from the equipment, main engines and auxiliary engines, and other equipment requiring cooling water.

Figure 7 indicates the lubricating oil storage tanks; figure 8, the gas regulator house; figure 9, the 100,000 gallon overhead water tank; figure 10, the house serving the sump pump; figure 11, the gas manifold piping directly in front of the cooling tower; figure 12, the cooling tower; figure 13, the pipes storage racks and area in which other heavy equipment is stored; figure 14 the pipeline warehouse serving the forces of the pipeline department located at Station 6, which forces are under the supervision of Mr. R. G. Strong, but the building is included within the compressor station plant investment. Figure 15 shows the overhead domestic water tank. Figure 16 shows one of the garages provided for the employees. Figure 17 shows the cottage area and road.

The broad white line near the right side of the picture is the main highway from Beatrice, Nebraska, to Lincoln, Nebraska. The small white lines running past the main engine building and the auxiliary building down to the office building and up toward the houses are sidewalks serving the various facilities and cottages.

(At this point counsel for defendants offered EXHIBIT 96 in evidence, and it was received without objection.)

In addition to the equipment shown on Exhibit 96, other equipment has been added from time to time up to the present time. There has been an extension made to the cooling tower. There has been an extension made for the main building. That extension is on the side
605 away from the auxiliary building. There have been roads added to the main plant site. There have been other cottages constructed on the plant site, and I believe that is all the major additions. There is one observation I might make here, that the usual layout includes water wells on the plant site. Unfortunately, we could not locate water wells on the plant site at Station No. 6 and those wells are located approximately a mile away to the left side of the picture. A water line has subsequently been installed out to the location of the water wells, and in addition, at Station 6 we have a water line leading from the station into Beatrice to supplement the supply of water for our own use at that station.

There are 30 acres in the plant site at Station 6. The limits are not very well defined. However, they are shown roughly by the main highway on the west, the dirt road immediately in the foreground from the main building on the north, and there is a fence to the south of the cottage area. There is a faint line running along the middle left-hand section of the picture which may be traced as the property boundary. It is approximately a prolongation of the left side of that dark field which is about the upper center of the picture.

There are also dust scrubbers located on the station site which are not included in this picture. We have three dust scrubbers at that station at this time.

(At this point counsel for defendants presented a document described as "Natural Gas Pipeline Company of America, Additional Capital Expenditures, Compressor Station Department, Witness W. H. Davidson." At the direction of the Examiner, the document was marked Exhibit 97 for identification.)

Exhibit 97 includes a tabulation of additional capital expenditures that will be required on the compressor stations of the Natural Gas Pipeline Company from the years 1939 to 1954, inclusive. It also includes a tabulation of the retirement and salvage on capital expenditures for those years.

Referring to page 1 of that exhibit, the details of the item "Equipment" in line 1 are set out more fully on page 2 of the exhibit; and lines 2, 3, 4, and 5 on page 1 are set out more fully in detail at pages 4, 5, 5, and 6, respectively, of the exhibit.

Under the subheading "Book Cost of Equipment Retired," lines 7, 8, 9, 10, and 11, entitled "Equipment," "Main Engines," "Yard Piping," "Buildings and Grounds," and "Bunk House and Dwelling," are set out more fully in detail on pages 3, 4, 5, 5, and 6 of Exhibit 97.

Under the subheading "Salvage" line 13, entitled "Equipment," the items referred to are set out in more detail on page 3 of the exhibit.

I was here yesterday when Mr. Powers testified, and heard all of his testimony.

I am now requested to take page 2 of Exhibit 97 and
606 explain the items numbered 1 to 28, inclusive, and state the necessity for the expenditures set out on that page in the years 1939 to 1950, inclusive.

First I will say that the definitions Mr. Powers gave yesterday in his testimony of the items which I also have listed in my exhibit are in accordance with my understanding of the definition of those items, such as dust scrubbers, Griscom Russell Bentube gas cooling sections, etc. We have a number of pieces of equipment located at the compressor stations on the main line which are identical with those located at the compressor station at Fritch under Mr. Powers' supervision, and the equipment which is identical Mr. Powers has described very well.

Taking Item 1, in general the necessity for an expenditure of $83,534 for additional dust scrubbers in 1941 is the same as the reasons given by Mr. Powers. However, we on the main line have a slightly different situation from that of Mr. Powers at Fritch.

Dust is usually defined as foreign matter. This dust may be made up of iron oxide, sand, scale or any other foreign material. The common nomenclature for such material is dust. In the operation of this line there accumulates on the interior wall of the pipe scale or dust. Periodically this scale or dust breaks loose, and it seems to accumulate as the gas pushes it forward. It might be described as an internal dust storm, because that is exactly what it is.

I believe the use of the words dust storm is common nomenclature in the pipeline industry. I know that I have heard the term used for a number of years. It is not the

same kind of a dust storm that Mr. Powers referred to yesterday in describing the dust storms of the Texas Panhandle; but I imagine it is pretty bad inside the pipe.

The turbulence of the gas as it accumulates scale seems to increase the intensity of the internal dust storm, until it reaches a compressor station and passes through the dust scrubbers, which are designed to take out such foreign materials. It has been our experience in the past that when such dust storms occur inside of the pipe, the present scrubber installation is not adequate to separate this dust from the gas, and a large portion of it passes on over into the suction line heading to the station, thence through the compressors, where it creates a very serious condition.

When I described those dust storms a moment ago and the reason for them, I meant that when a small amount of dust starts to break loose in the pipe, as the velocity of the gas containing that small amount of dust continues up the pipeline, it breaks off other particles of dust on the inside of the pipe, and that accumulation increases from time to time until you have what you term a dust storm on the inside of the pipe. The dust that is broken loose seems to form an abrasive to knock off other pieces of scale or dust on the walls of the pipe.

There are now three dust scrubbers located on the inlet of each compressor station. The expenditure as shown
607 in the year 1941 provides for the installation of one additional dust scrubber at each of the Stations 2 to 10 inclusive. That represents an expenditure, roughly, of $9,300 per station.

The next item, No. 2, is entitled "Renew Griscom Russell Bentube Gas Cooling Sections, Stations 2 to 10, Inclusive." I believe Mr. Powers discussed this item, which he installed at the Fritch compressor station. The same reasons for making such new installation on Stations 2 to 10 prevail as prevailed at Fritch.

There are 24 C-169 Bentube sections installed at each station. It will be necessary to renew these gas cooling sections, installing the sections at two stations in each of the years 1944, 1945, 1946, and 1947, and in one station in 1948. It is very possible that we will be required to install all of these sections before the year 1948. However, it is customary in our company when doing work of this magnitude to spread it out over a short period of time. The volume of work to be done at all of these stations in any one year is so great that you spread the work out over a

period of years so it will be more properly and efficiently handled. It is not possible to continue the operations of the pipeline and have a number of stations out of service at the same time, because the capacity of the pipeline is thus greatly reduced.

Items 3 to 10, inclusive, have to do with the drilling and equipping of water wells at stations 2 to 9 inclusive. All of the compressor stations on the main section of the pipeline secure the necessary cooled water from water wells which are either drilled on the plant site or in the near vicinity. Continuous station operation depends directly upon an uninterrupted supply of good quality water in sufficient quantity. Water make up requirements over the system vary considerably. They vary according to the load carried on the pipeline, and they also vary with climatic conditions but to explain that would get us into a discussion of relative humidity, wind and atmospheric temperature. Generally speaking, we would probably use a little more water in the summer time than in the winter, providing the load is anywhere near normal. On the average, the requirements of these stations will fluctuate between 60,000 and 200,000 gallons of make-up water per day for each station.

As I use the term "make-up water," it is that water that is required to be added to the system in order that sufficient circulating water may be provided for the operation of the plant.

Our water well problems over the system are ever present. Naturally, over such a long distance, quantities and qualities of available water vary quite widely. The water problem becomes more complex each year and each location has its own individual characteristics and peculiarities. The experience with water wells on this system indicates that only with the future drilling of new wells will we be able to meet the necessary requirements.

We have set up, and have had set up the last two or three years, a definite water well drilling program to offset any possibility of depleting the water supply at the several stations. The supply of water in the wells that have been
608 drilled in the past has been depleted at a number of stations. At Station 2, for example, the history of the water wells at this point shows a tendency for these wells to sand up. The water bearing stratum is extremely fine grain sand. Three water wells have already been drilled at this station, in addition to the original wells that were installed at the time the plant was constructed. These wells

were drilled in 1931, 1934, and 1938. Due to our past experience on the wells already drilled at Station 2, it will be necessary to drill additional wells to augment the existing supply in the years 1942, 1946 and 1950. They might be required sooner than that.

Item 7, "Drill and Equip 3 Water Wells, Station 6, and Construct Pipeline and Power Line," requires an expenditure of $50,094 in 1941, and $7,177 in 1947. We have had trouble with our water wells originally drilled at Station 6 from the time the station was first placed into operation. These wells are drilled off the station site and are shallow wells, approximately 37 feet deep. They produce from a formation almost entirely dependent upon seasonal rainfall. This area has suffered several protracted drouths, and it has created a condition in these wells where they are entirely inadequate.

This problem became serious enough in 1934 that the company constructed a pipeline to the city limits of Beatrice, Nebraska, and arranged to purchase water from the city. This service has been thoroughly satisfactory in so far as the quality of water is concerned. However, there have been times when water requirements for the city of Beatrice have been so heavy, particularly in the summer months, that the pressure of the water delivered to our plant was too low to allow the water to be passed through the water treating plant which softens the water.

The city of Beatrice naturally protects its own interests first. Not less than ten days ago we had an occasion to shut down Station 6 for the purpose of cleaning out the entire system, that is, the system which holds the water for the plant. We are not allowed to shut down these plants for any great length of time. Six to eight hours is considered a long shut-down period, and it is very necessary that we start the plants up on immediate notice.

The occasion of which I speak occurred when we had authority for such shut-down. Upon starting up we were delayed to a considerable extent in getting under way and starting again to pump gas, because we could not secure sufficient quantities of water from the mains leading to the city limits of Beatrice.

There is a further complication surrounding the water situation at Beatrice. The city operates under a contract with the Layne-Western Water Well Company. The Wayne Water people drilled several wells, and sell the water to the city, and the city has an option to purchase the line

and the wells at any time. I have been informed from a very reliable source, and it is a matter of public record and there have been articles in the newspapers, that the city of Beatrice is arranging to purchase the line and water wells serving that town. We are only able to secure water for our plant use at Beatrice from the city of Beatrice
609 due to our contacts with the Layne-Western Well people, who also drill our own water wells. It is very doubtful if we can long continue securing water from the city of Beatrice if they purchase that plant, as it is rumored they will.

The public record I speak of is proceedings of the city council of Beatrice. I have been informed by this reliable source that a resolution has been introduced and that there have been proceedings before the council, the nature of which was that they would purchase the water system now owned by the Layne-Western people, under the city's option to purchase the wells and water line, and there have also been numerous newspaper articles in the daily papers of Beatrice to that effect.

Our own water wells originally drilled, as mentioned before, are entirely inadequate. They are only capable of producing from 25 to 50 gallons a minute, and for the reasons stated we have shown an expenditure of $50,094, which includes the cost for drilling water wells at Blue River, approximately four miles away from our plant, and constructing a pipeline and a power line to that point to transport water to the station site for plant use.

We transmit our own power from our station to the water wells for pumping purposes. We are doing that in a number of instances. We have automatic devices at the well, electrically controlled at our plant, for running these wells. That is electric power, and we generate all of our own electric power.

Questions by the Examiner.

I don't think I can state exactly in hours or minutes how long that interruption, caused by lack of water, was, that is, the time representing the difference between the time we would normally have been able to start up and the time we actually did. When I used the term "authorized," it was authorized by the dispatching department and with the consent of the management. There are several duties which we must perform at each compressor station at least once or

twice per year, and we watch for the time when we can shut down the station for a very short period of time and get those things performed.

There are, of course, some deliveries being made from the line at the time. There might be a number of things done to take the place of Station 6. Usually the line is packed up pretty well before such an allowance is made to shut down the station. When I say "pack" I do not mean that we run our pressures above normal. We never exceed a maximum pressure, which is 712 pounds, but we secure a higher gradient, possibly, between stations.

Direct Examination Resumed by Mr. Hedrick.

In other words, with reference to the time the station was shut down, I stated that it was in the neighborhood of seven hours, for repairs, and when we wanted to start up we were delayed by reason of not having a sufficient
610 quantity of water from Beatrice. I am not able to state how much of the delay was occasioned by the shortage of water. I can determine that later, but I don't have it right now.

When a station is shut down we completely stop the engines, but before doing that we increase the quantity of gas contained in the line by higher pressures at other places along the pipeline, such as between Stations 9 and 10, or 8 and 9, etc., before we shut down that station.

Questions by the Examiner.

As to what would happen between Stations 5 and 7, naturally Station 7 will have a lower intake pressure into the station than it would normally have from Station 6. Station 7 can draw the line back to Station 5 through the by-pass. The gas in effect goes by the station on its normal course and it is just not pushed for that period of time or compressed for that period of time at Station 6, or at any other station that might be out. There is an amount of gas that does go right on by the station, but in somewhat reduced volumes.

Whether we could change our intake draw from Station 7 and our output pressure at Station 5 to completely cover the effect of taking out Station 6 would depend on what the delivery happened to be at that time. If the delivery was a low enough quantity we could do that.

Direct Examination Resumed by Mr. Hedrick.

When we increase our line pack prior to shutting down the station, we do that by raising our intake pressures at the other stations, so as to pull additional quantities of gas into the plant, thus making up somewhat for the shutdown of Station 6, for instance.

Going back to the question which the Examiner asked with reference to the shutting down of Station 6 and the result of shutting that station down, and how we could shut it down without serious impairment of deliveries of gas to our customers, I will endeavor to explain the steps which are taken in such a station shutdown, using, for example, a shut-out at Station 6.

Before such a shut-out is possible we must have deliveries somewhat below normal. To prepare for such a shut-out the line ahead of Station 6 is packed. By the word "pack" I mean that the average pressure on that line is raised, or that the intake pressure to any station ahead of Station 6, being Stations 7, 8, 9 and 10, is raised above what it normally would be. In other words, there is an additional volume of gas stored in the pipeline by virtue of the higher pressures than normally would be in that length of pipeline.

When that condition is reached, Station 6 may shut down for a period of time, that period of time depending entirely upon the volumetric take ahead of Station 6. As the pressures in the pipeline ahead of Station 6 fall below normal pressures, by which I mean pressures of the intake side of the station, then it is necessary to start Station 6 into 611 operation and to proceed under normal conditions.

While the station is shut-out, it is possible by the manipulation of valves to allow the gas to pass up the pipe line, what we term, by-pass the station, in reduced volumes. The pressure between any two stations ahead of Station 6 is raised from an average standpoint, but it is not raised above the limitation of 712 pounds at the discharge side of the station.

With reference to the shutdown of Station 6 about which I testified a moment ago, I cannot say what the effect of the shutdown of that station was on the balance of the pipeline because I have been engaged in other duties, such as the preparation of this exhibit. However, I have been informed by Mr. W. T. Bulla, who has charge of pressure dispatching, that the time over the normal time that the

station would have been shut down was two and three-quarters hours by reason of lack of water for the circulating water system which is secured from Beatrice, Nebraska, and that he has had difficulties since that time maintaining proper pressures on the system.

Questions by the Examiner.

To explain that we must go back to the fundamentals of this shut-out. I believe I stated that it would be necessary for Station 6 to start up after such a shut-out after the pressures on the intake of the stations ahead of No. 6 fell below normal. When we schedule a shut-out we know from experience just about what length of time that will take. Inasmuch as we were not able to start up the station on schedule, those pressures fell below normal pressures, and the gas continued to flow out at the end of the line, and we have not been able to get up to or to realize those pressures since that date. I am not positive whether that condition still exists, but it did exist for some period of time after this particular occasion.

When we cut out and come back on the line at a station according to schedule, we establish normal conditions without any difficulty on the line. Schedules for shut-outs must be studied very carefully before such shut-outs are granted. We know our commitments fairly well, and only schedule shut-outs for such period of time as commitments will allow.

Direct Examination Resumed by Mr. Hedrick.

Proceeding to Item 8, entitled "Drill and Equip 2 Water Wells at Station 7," with an expenditure in the year 1940 and another in 1946, I will explain the situation at Station 7 and the necessity for these expenditures.

The wells at Station 7 are located approximately 8,000 feet from the station site. These wells are comparatively shallow. They are 59 feet deep. They are also dependent to some extent on seasonal rainfall.

When preparing this exhibit we knew that the water wells at Station 7 were none too stable. We included provision for an additional well at Station 7 in the amount of $7,559 in the year 1940. We were a little optimistic in

that regard, as we have experienced trouble with both
612 existing wells at Station 7, that trouble resulting from clay clogging up the sand. We are now securing quotations, and I have authority from the management to drill an additional water well at Station 7 just as soon as we can get it in, that is, in the year 1939. We also provided for an additional well to be installed in 1946, at a cost of $7,559.

Line 10 is entitled "Drill and Equip 2 Water Wells, Station 9." In the past we have suffered many difficulties from the water situation at Station 9. The original deep wells located at this station supplied a quantity of water which was extremely hard and corrosive. After attempting to operate this station with such water for several years, with very poor results, we drilled two water wells in the Skunk River bottom, which is some seven miles south of the plant site.

The wells provide a much better supply of water. However, the water does contain a quantity of iron. We do not hope to operate these wells at their present capacity beyond the year 1944, and have provided for the installation of an additional well at a cost of $6,619 in 1944, and for still another well at the same cost in 1948.

Going back to Item 4 concerning the drilling and equipping of three water wells at Station 3 in 1941, 1945 and 1949, the situation of the water supply at Station 3 presents still a different problem than any heretofore mentioned. The supply of water at this station has held up to a fair degree. However, the quality has not held up as desired. The water from the two original pumping wells at this station has become harder and the total solids have also increased appreciably. It has already been necessary to drill one additional well at this station. This well was drilled in 1938, and some relief and decrease in hardness and chloride content was noticeable in the other wells by reason of the fact that they did not require the amount of pumping time that was necessary with only two wells.

As the wells become older, the water bearing strata immediately around the well become less porous, and the inlet screen in the well becomes corroded, which does not allow as much water to enter the well as would enter a new well. These wells will produce less water with age. They will also contain an increase in total solids and hardness and chloride content as they are pumped harder in an

effort to make up the necessary water requirements. We have therefore provided for the installation of three additional water wells at Station 3, to be installed, one each, in the years 1941, 1945 and 1949.

Item 5 covers the necessity for drilling and equipping two water wells at Station 4, with expenditures in 1941 and 1947 for that purpose. There again the wells at this station are shallow. They are 52 feet deep. They are also affected to some extent by seasonal conditions. These wells at the present time are becoming harder, that is, the water from these wells is becoming harder, and in line with our water well drilling program we have provided for one additional water well at Station 4 in each of the years 1941 and 1947, at a cost of $8,076.

Item 6 covers the necessity for drilling and equip-
613 ping two water wells at Station 5 with an expenditure in 1942 and another in 1948. The same general reasons exist at Station 5 as those described for the preceding station.

Item 9 relates to the necessity for the expenditure of $7,876 in each of the years 1941, 1945 and 1949 in drilling three water wells at Station 8. All of the present wells serving this plant are at a considerable distance from the plant site. The plant is located near Truro, Iowa, in what I have been informed is a glacial drift area. The water producing sands existing in this area are not necessarily connected. This fact precludes the possibility of drilling wells closely together without securing what we term sympathetic action. By that I mean when wells are drilled closely together one well will very nearly produce the same quantity of water as two or more wells, or, in other words, the water is secured from a pocket or confined sand of fairly narrow limitations.

This fact was illustrated in our original wells drilled for that station, which are located approximately 150 feet apart, and it was found upon pumping any one of the three wells that the water table went down correspondingly in the adjacent wells. The problem of an adequate supply of water at Station 8 was the subject of considerable study by myself and the engineering department.

We made an exhaustive study of the surrounding vicinity and made numerous test drillings with a test rig, which showed the possible formations that we might encounter in our search for an ample water producing sand. It was found that we could not secure water of sufficient quanti-

ties in the immediate vicinity of our original wells. Therefore, we drilled additional wells to augment the original supply at a considerable distance away from the original wells. The survey as made has not been encouraging. The Layne-Western Water Well people, who drilled these wells for us, have been very pessimistic in their opinions regarding a continuous supply of water in sufficient quantities for this station.

However, we have scheduled the drilling of additional wells in this area, to be located at a considerable distance from the existing wells, for the future. Our only other alternative is to construct a pipeline and drill wells farther away from the plant site than the existing wells, at an expenditure much greater than that shown in this exhibit. We, therefore, have shown the installation of one well for Station 8 in each of the years 1941, 1945 and 1949, in the amount of $7,876.

Item 11 is entitled "Install Water Treating Tower at Station 10." A water treating tower as included in this exhibit describes a tower which will be erected in 1939, and is now under process of being designed, for the treatment of circulating water at Station 10.

This is necessary because the water produced from the deep wells now being operated at Station 10 has been corrosive since the station was first put into operation. One of these two wells became inoperative in 1935, due to corrosion in the casing allowing the upper strata 614 of clay and sand to fill in and make the well practically inoperative.

We repaired that condition by installing a casing liner. We were not able, however, to inhibit the corrosive elements of the water in daily use for the equipment in the plant, although we tried numerous methods. Our Mr. Hammerschmidt, chief chemist, located at Fritch, Texas, made a number of experiments on this water problem at Station 10. He has followed the serious problem of corrosion at this point for a number of years. Through his efforts, he devised a means by which the water might be treated with the use of natural gas, which would inhibit the corrosive tendencies of that water.

We followed the initial experimental findings with a test or pilot plant at Station 10 in which we endeavored to simulate the actual operating conditions as much as possible. The result of this continued experiment was gratifying to the point that we have secured authority to

proceed with the design of a tower and other apparatus which will treat the water at this plant and make it usable and uncorrosive.

This study of the water problem at this plant has taken a considerable length of time. It is not possible to secure water in sufficient quantities for plant use from any other strata than those from which we are now securing that water, and all of the water from that source is corrosive. The only other alternative is to search for a sufficient supply of water near the Green River, which is located north of the city of Geneseo and some seven miles from our existing plant site. We hope by the installation of the water treating tower at Station 10 to be able to utilize our present supply of water from the deep wells at that ppint and to prevent the expenditure of over $75,000 for the drilling of additional wells on Green River and the laying of the necessary pipe and power lines to serve those wells. The exhibit, therefore, shows an amount of $5,500 which will be expended in 1939 for the erection of a water treating tower at Station 10.

Item 12 refers to an expenditure of $11,190 in 1940 for a water treating plant at Station 9. I believe I stated when describing the water well situation at Station 9 that the original wells were extremely hard. In fact, they were in the neighborhood of 200 grains in hardness. This water could not be treated or softened economically by any known method. We attempted to operate the plant without benefit of a water treating system.

When we constructed the power and water line serving the new wells in the Skunk River bottom, we were hopeful that we might be able to operate that plant on the new water so obtained without the use of further water treatment. This water is from seven to nine grains in hardness.

After approximately two years of operating the station on that water, we have found that scale is built up in the system, particularly in the engine cylinders and exhaust valves and other points of high temperature. This scale has been detrimental in the disintegration of the various engine parts, and has also increased the rate of wear on the cylinders and exhaust valves. We desire to operate our engines with cooling water at as near zero hardness as is possible to secure. We have included in the exhibit under Item 12 a sum of $11,190 for the installation of a water treating plant at Station 9 in 1940.

615

Item 13 relates to an expenditure in 1945, 1946 and 1947

to renew redwood cooling towers at Stations 2 to 10, inclusive. I heard Mr. Powers' testimony yesterday as to the necessity for a like item at Station 1, and the necessity for the renewal of the cooling towers at Stations 2 to 10 is the same as that about which Mr. Powers testified. In other words, by 1945 these cooling towers will wear out and have to be replaced.

Not later than 1945 we will be required to renew the cooling towers at Stations 2, 3 and 4, in the amount of $20,740. In 1946 we will renew the cooling towers at Stations 5, 6 and 7, in the amount of $20,904; and in 1947 we will renew the towers at Stations 8, 9 and 10, in the amount of $23,976. I have had considerable experience in the past in maintaining these cooling towers at the various stations under my supervision.

Questions by the Examiner.

The cooling towers were part of the original construction in each case. We do not believe that one tower will necessarily outlive the other; but, as explained under Item 2, page 2, it is our policy to spread such construction over a period of time, as it is not usually possible, in view of our operating conditions to make an overall installation in one year.

Direct Examination Resumed by Mr. Hedrick.

In other words, we could not shut down all of our stations at one time in order to install cooling towers. We could not even construct one cooling tower at any station that was operating as rapidly as we might construct a cooling tower at a station which was not in operation. We would have to do it piecemeal. Therefore, it takes a longer period of time for that construction work to be completed at any particular station. There will be periodic shut-outs of short duration necessary as we are constructing a tower. Obviously, we could not shut the station down long enough to tear the old tower down and build a new one.

Item 14 is an expenditure of $4,354 in 1939 to install rotary air compressors and piping at Stations 2 to 10, inclusive. I am not positive whether or not Mr. Powers testified with respect to this particular air compressor. However, this item has already been installed this year.

Item 15 is an expenditure of $2,745 in 1944 to renew sump pumps at Stations 2 to 10, inclusive. Each station is equipped with what is known as a sump or hot well, 10 feet by 10 feet, such as is shown at No. 10 on Exhibit 96. The duty of the pump installed within the building, shown by the figure 10 on Exhibit 96, is to pump hot exhaust water. This pump is on almost continuous duty. The water from the exhaust mufflers is corrosive in nature and frequently repairs are necessary on these pumps. The condition prevailing on these pumps over the system at the present
616 time will make it necessary to renew all pumps not later than 1944, in the amount of $2,745.

Item 16 is an expenditure in 1939 and another in 1940 to renew impellers in centrifugal water pumps. An impeller may be otherwise defined as a water wheel, attached to a rotating shaft, encased within a pump, which performs the duty of pumping water.

The original pumps installed at each station for pumping circulating water were equipped with 1,750 gallons per minute bronze impellers. This capacity is slightly under the desired capacity for pumps in this service, and to provide additional capacity for the water pumping equipment, 2,000 gallons per minute impellers have been installed at Stations 2, 3, and 9. As it will be necessary in the future to replace the original impellers within the water pumps at the remaining stations, these impellers will be of the 2,000 gallons per minute size to provide the additional capacity needed.

Item 17 represents expenditures in 1943, 1944 and 1945 to renew bottom in 100,000 gallon water tank at Stations 2 to 9, inclusive. The original water tank installed at each station was equipped with an ellipsoidal bottom. The pitch or slope of this bottom was fairly low. In the course of our yearly overhaul of all equipment, we inspect the interior of these water tanks. The inspection has indicated that there is corrosion existing on the shell and bottom of all tanks to a varying degree.

The corrosion in the water tank at Station 10 was very bad last year, and had progressed to a point where a new bottom was mandatory. The new bottom installed was of a greater slope or pitch and is a conispherical bottom rather than an ellipsoidal bottom. The conditions as existing in the other overhead tanks on the pipeline will require the renewals of the tank bottom at Stations 7, 8 and 9 in 1943,

at Stations 4, 5 and 6 in 1944, and at Stations 2 and 3 in 1945.

Item 18 represents an expenditure in 1939 to install lightning protection at water wells at Stations 4, 6, 7, 8 and 9. That item is under construction or installation at the present time.

Item 19 represents an expenditure of $3,039 in 1939 to increase lighting capacity at Stations 2 to 10, inclusive. That item is also now under construction.

Item 20 represents expenditures in 1939 and 1940 to caulk and install dust filtration equipment in auxiliary building at Stations 2 to 6, inclusive. We have at the present time dust protection equipment installed in the main compressor building at Stations 2, 3 and 4. The success enjoyed by such dust filtration equipment has led to a definite program for so equipping other buildings housing machinery at those plants in the dust area.

Since we have been in operation on this pipeline we have experienced many, many dust storms, as described by
617 Mr. Powers in his testimony. The dust area includes Fritch and Stations 2 to 6, inclusive. There are milder storms periodically to the east of Station 6; but these storms are not of sufficient intensity nor do they occur frequently enough to require dust filtration equipment beyond Station 6. We will install dust filtration equipment in the auxiliary building at Stations 2, 3 and 4 in the year 1939, at a cost of $6,210, and we will install dust filtration equipment at Stations 5 and 6 in the amount of $4,140 in 1940.

Item 21 is for caulking and installing dust filtration equipment in the main building at Stations 5 and 6. The necessity for that installation is the same as that explained concerning Item 20. We have already done that at Stations 2, 3 and 4.

Item 22 is an expenditure in 1942 to renew boiler blow-down pits at all stations except Station 7. The boiler blow-down pit is a small concrete pit located outside of the auxiliary building and directly behind the heating boiler. It is used to receive the condensate from the boiler which is periodically blown down. This small pit, built of concrete, disintegrates under such service. It has been necessary to renew the pit at Station 7. The boiler blow-down pits at all of the stations will be renewed not later than 1942, at a cost of $904.

Item 23 represents an expenditure in 1946, 1947 and

1948 to renew oil centrifuges at all stations. My explanation as to the necessity for this installation is the same as that which was given by Mr. Powers concerning the Fritch station.

In 1946 we will renew the centrifuges at Stations 2, 3 and 4, at a cost of $3,405; in 1947 we will renew the centrifuges at Stations 5, 6, 7, and 9 at a cost of $4,540, and in 1948 we will renew the centrifuges at Stations 8 and 10, at a cost of $2,270.

Item 24 is an expenditure in 1941 of $41,590 to construct and equip central machine shop. I believe Mr. Powers testified as to the necessity for renewing certain machine shop equipment and tools at Fritch. That station is already provided with more machine shop equipment than any station on the main line, and, with the additions to be made, will be able to handle a large amount of the necessary work that will be required in the coming years as the machinery deteriorates or requires certain types of repair.

We are greatly handicapped at the present time in securing machine work of the nature we desire. That is principally caused by the fact that our pipeline runs through an area that is not industrial and it is a very difficult thing to secure adequate machine shop service at those points or within any reasonable radius of such stations.

Furthermore, when we are able to secure such service, it is usually in a railroad machine shop, or it is in some manufacturing plant which operates their machines on a production line. We attempt, in our repair schedule and overhaul procedure, to do certain things in sequence and it is very necessary for us to have the work performed
618 on that schedule. Like all other facilities serving our plant, we do not wish, nor can we afford, to depend upon outside service. We must have such facilities within our control.

There are many items under the maintenance schedule shown in a later exhibit which will require machine work, and for that reason, in order to provide an adequate machine shop for our own use, we will build such a machine shop, equipped with the proper tools, not later than 1941. We will build that machine shop at Station 6.

The need for such a machine shop for the proper and efficient maintenance program facing us in the future will be much greater than it has been in the past. Each succeeding year brings the necessity to a greater extent for such machine tools.

Item 25 is an expenditure of $8,019 to install fire pumps at all stations, and has been completed in 1939.

Item 26 is an expenditure of $4,354 in 1939, and $1,100 in each of the years from then on until 1950, for tools. All tools, other than miscellaneous operating tools, and being those tools costing in excess of $25, are charged into the plant account. Each year of operation it is necessary to add special tools for the performance of specialized repair work. Each year we have added tools. In 1939 we have already purchased tools not heretofore carried, at each station.

For example, we purchased an air drill for each station. We now have on order steel trucks, which will be utilized to store and carry the repair crews' tools. We have also purchased corrosion testing equipment, as explained under Item 11, in connection with the water treating experiments at Station 10. Other tools have been authorized for purchase this year, and include metallizing equipment, tool post grinders, and other smaller tools in the category I mentioned. In future years after 1939 we will purchase tools at least to the extent of $1,100 per year, up to and including the year 1950.

Item 27 is an expenditure of $356 in 1939 for a power lawn mower at Station 6. That item has been purchased and is now in use.

Item 28 is an expenditure in 1939 of $1,710 to construct wash racks at Stations 2 to 10, inclusive. That item has been approved and is now in the process of design and will shortly be installed.

Questions by the Examiner.

I am asked to explain what is meant by these reclaim designations. I believe Mr. Powers in his exhibit showed the reclaim in a manner similar to mine. The asterisks behind the figures only indicate that there is a retirement of those items. Answering whether that price figure which has a reclaim designation is the figure of the cost new less the amount of the reclaim, I will say that we have included in the figures as tabulated on page 2 the new cost in some
619. instances, that is, the cost of new materials where it was not possible to use any of the material retired.

In other instances we have utilized some of the material as salvage in the new installations; but the asterisk itself only denotes retirement of that specific item.

Cross-Examination Interposed by Mr. Slaff.

The amounts of expenditures set down for each year are based on prices of materials and prices for labor as of June 1, 1939. That is not true as to the salvage value. We have projected into salvage our judgment of what the salvage value will be at some future date. The salvage is the book cost of that usable material that is recovered from the plant and used in another investment or placed into material stock.

Going back to my statement with respect to the amount of additional capital expenditures for all of the years beyond 1939, the statement I made applies throughout the entire exhibit in so far as new materials to be purchased are concerned and also with respect to prices of labor.

I was here yesterday and heard Mr. Powers' testimony. It is true with respect to me as with respect to him that I am not qualified and have not attempted to be qualified to give an expert opinion on the future economics of this country and future prices. I have not attempted to make any economic study of future prices. I have been instructed to use the prices as of June 1, 1939.

(Objection by Commission Counsel to further testimony with respect to prices beyond 1939, motion to strike all testimony to this point on that subject, objection to such line of examination, and motion to strike testimony on ground that it is purely speculative and does not concern itself with the reasonably immediate future overruled and motions denied.)

Cross-Examination Interposed by Mr. Booth.

The June 1, 1939, prices which are used in this exhibit were obtained largely through our purchasing department, which is in daily contact with vendors of such materials as are included in this exhibit.

Direct Examination Resumed by Mr. Hedrick.

I secured that information through the purchasing department of Natural Gas Pipeline Company.

Referring to page 3 of Exhibit 97, the retirements on that page are retirements of property to be retired on account of renewal or installation of property shown on page 2, which takes the place of the property retired shown

on page 3, and the asterisks on page 2 refer directly to items on page 3. In other words, the second item on page 2 shows an expenditure in 1944 of $43,020 for renewal of Griscom Russell Bentube Gas Cooling Sections, and the book cost of the Griscom Russell Bentube section which will be retired at that time is $27,794.

Cross-Examination Interposed by Mr. Slaff.

The term "reclaimed" is used because that is a term which is normally used when making retirements from capital investment. It does not necessarily mean reclaim in the sense that there will be salvage. On some of the items on which retirement or reclaim is shown, there is salvage. It is used on page 2 in the sense of being synonymous with the word "retirement."

620 (The Examiner here made the inquiry of whether the term "reclaim" is a variable term in the accounting department of defendants. He stated that in Mr. Powers' case the words "retirement" and "salvage" were used, and inquired whether the word "reclaim" appeared in one sense in one place and other words appeared in other places, and whether its appearance here depended upon the fact that at one time they thought they would have salvage value and other times would not. Counsel for defendants thereupon stated that he might be responsible for that; that they had been in a considerable hurry to get these exhibits prepared, and after this exhibit had been mimeographed he noticed the word "reclaim" instead of "retirement" but told Mr. Davidson not to have the page remimeographed, as counsel could explain, as Mr. Slaff suggested, that the words are synonymous.)

Question by the Examiner.

When I used the term "reclaim" I did not think there was some salvage connected with the items which I subsequently decided there would not be.

Direct Examination by Mr. Hedrick Resumed.

I am not an accountant.

On page 3 is a sub-heading, "Salvage." Item 2 shows that on account of the water wells that will be installed

at Station 2 in 1946 there will be a salvage value from a well retired to the amount of $2,559, and so on throughout the balance of the page. That salvage is figured at the actual cost as shown by the books of the company for that particular equipment.

(Counsel for defendants thereupon stated that, as he understood it, when casing is taken out of a water well and put into another well, it is charged into the capital investment in the second well at its actual cost as reflected by the books; that it is not salvage in the sense that they are going to talk about at the next session; and that it is just a bookkeeping term which counsel is informed will be included in the bookkeeping requirements promulgated by the Federal Power Commission in 1940. Counsel also stated that it was intended to put the secretary of the Company on to explain some of those bookkeeping details.)

Referring to page 4, Mr. Powers testified yesterday to similar items referred to under Items 1, 2, 3 and 4, and the testimony given by him as to the necessity for those capital expenditures is the same explanation as I would give so far as the stations under my supervision are concerned.

Item 1, entitled "Replace Nugent Oil Filters with Cuno Oil Filters," at an expenditure of $4,386 in the year 1939, will be made at all stations Nos. 2 to 10, inclusive.

Item 2, entitled "Convert Worthington Air Filters to Water Wash Type," will be installed at Stations 4, 5, 6 621 and 7 in the year 1939 in the amount of $1,600.

Item 3, entitled "Renew Main Engine Air Filters," will be installed at Stations 2, 3, and 4 on 17 units in the year 1944; and at Stations 5, 6 and 7 on 15 units, in the amount of $4,500, in 1945.

Item 4, entitled "Renew Main Engine Exhaust Mufflers," in the amount of $10,968, provides for the renewal of exhaust mufflers on 12 engines at Stations 2 and 3 in 1939. The amount of $32,904 appearing in the year 1940 provides for the renewal of exhaust mufflers on 36 engines at Stations 4, 5, 6, 7, 8, 9 and 10 in 1940.

The book cost of equipment retired from main engines shown at the bottom of page 4 would be explained in the same manner as I explained similar matters on page 3 of this exhibit.

The date used by me in determining prices for labor and material going into the capital expenditures contained in Exhibit 97 was June 1, 1939. I prepared that exhibit.

Referring to Exhibit 97 as a whole, the amounts shown

thereon for labor and material and other items going into the additional capital expenditures shown in this exhibit represent my considered judgment at this time, based on prices as of June 1, 1939, and based on the experience which I have gained through my employment with Natural Gas Pipeline Company and other experience arising out of my previous employment. (Objection by Commission Counsel overruled.)

Questions by the Examiner.

In giving my answer I mean that so far as prices enter into it, they are based on prices as of June 1, 1939. I have no opinion regarding prices at all. The amounts are based upon my judgment, using prices as of June 1, 1939. My judgment relates to the amount of material and the quantities which I have used and their necessity from an engineering standpoint. I confined my judgment to the two elements of labor and material. (Renewal of motion by Commission Counsel to strike from record all testimony with respect to prices at costs beyond the year 1939 denied.)

Direct Examination by Mr. Morgan.

The various items of addition and replacement set forth in Exhibit 97 represent my considered judgment, based on my experience in the position I occupy, as to expenditure it will be necessary to make at times not later than those indicated in this exhibit, basing the figures set forth in the exhibit upon prices of labor and upon material and equipment costs as of June 1, 1939.

Everything in this exhibit represents my considered judgment, except the element of prices, which are based upon those furnished me by the purchasing costs as of June 1, 1939.

Cross-Examination Interposed by Mr. Slaff.

622 I have considered in this exhibit prices as of June 1, 1939, but I have not formed any judgment as to what prices will be in each of the years 1940 to 1954, inclusive.

With respect to Item 10, page 3, the impellers to be retired will be at those stations where the new impellers are to be installed.

Direct Examination by Mr. Hedrick, Resumed.

The impellers will be installed at Stations 4, 5, 6, 7, 8 and 10, and the retirement is also at those stations.

The necessity for the expenditures listed on page 5 of Exhibit 97, for yard piping, buildings and grounds, is the same as that given in the testimony by Mr. Powers with reference to similar items.

Item 1 of those same items, entitled "Jacket 6-inch Discharge Lines," represents an expenditure of $7,311. This work will be performed at Stations 2, 3 and 4 on seventeen units in the year 1940. Like work will be performed at Stations 5, 6 and 7 on fifteen units in the year 1941, in the amount of $6,483. Also like work will be done at Stations 8, 9 and 10 on sixteen units in the amount of $6,897 in the year 1942.

Item 2, entitled "Renew 10 inch Discharge and After Cooler Headers," will be performed at Stations 2, 3 and 4 in the year 1939; 5, 6 and 7 in the year 1940; and 8, 9 and 10 in the year 1941. The amounts as shown in the years 1939, 1940 and 1941 represent the jacketing of the 6 inch inlet and outlet lines for the Griscom Russell gas cooling sections.

In the year 1943 the amount of $8,520 is the cost of renewing the 10 inch discharge and 10 inch after cooler headers at Stations 2, 3 and 4. The amount of $7,320, shown in 1944, is the cost of renewing the same headers at Stations 5, 6 and 7. The amount of $8,520, in 1945, is the cost of renewing the same headers at Stations 8, 9 and 10.

Item 3, entitled "Renew Muffler Drain Line," in the amount of $6,327, is for the renewal of this drain line at all nine stations in the year 1944.

Item 4, entitled "Renew Underground 3 inch Air Line," is the cost of renewing the 3 inch underground air line from the air receivers to the main building at eight stations in 1940.

I am not certain whether Mr. Powers testified as to the renewal of underground 3 inch air lines. There is a 3 inch air line which extends from the air receivers to the main building and is used to pipe air for starting the main engines. The air line was found to be in a bad state of repair at a number of stations. We have removed the air line at Station 2 and reinstalled it overhead. This Item 4 provides for the installation of a 3 inch air line now underground to an overhead location at all the other eight stations.

It is my judgment that, based on the experience which
623 I have gained as superintendent of the compressor stations of Natural Gas Pipeline Company, these items will have to be renewed as of the dates shown. Several of the items occurring on page 5 will undoubtedly need renewing before the dates shown.

My explanation of book cost of property retired is the same as my explanation of book cost of property retired with respect to page 3 of Exhibit 97.

Under the subtitle "Buildings and Grounds, Additional Capital Expenditures," Item 1, to install extensions to main buildings at Stations 2, 3, 6 and 7, has already been completed.

Item 2 is to install door checks on main and auxiliary buildings. My explanation for that is the same as that made by Mr. Powers in his testimony.

Items 3 and 4 are to install Transite roofs on main buildings and on auxiliary buildings. My testimony as to the necessity for this installation is the same as that given by Mr. Powers for similar items.

Question by the Examiner.

The principal element requiring the Transite roof is the corrosiveness from the water cooling tower spray on the one side and the exhaust water spray on the other. There is another factor which I do not believe Mr. Powers mentioned. This building, being constructed of sheet iron, is subject to quite a bit of expansion and contraction as it gets hot and cools off, and that seems to loosen the tie nails where the roof sheets are tied to the purlings.

Direct Examination Resumed by Mr. Hedrick.

The Transite roofs on the main buildings will be installed at Stations 2, 3 and 7 in 1940 at a cost of $11,267, at Stations 5, 6 and 9 in 1941 at a cost of $9,781, and at Station 8 in 1942 at a cost of $3,687. We have installed Transite roofs on the main buildings at Stations 4 and 10 prior to 1939.

We will install Transite roofs on the auxiliary buildings at Stations 4, 7 and 10 in 1941 at a cost of $3,867, at Stations 3, 5 and 9 in 1942 at a cost of $3,973, and at Stations 2, 6 and 8 in 1943 at a cost of $3,997.

Item 2 in the amount of $2,160 is for door checks which will be installed on swinging doors in the main and auxiliary buildings at all stations in 1939.

Item 5 is to install steel bins at warehouses and tool rooms at all stations in 1940, at a cost of $6,120. Mr. Powers testified as to the necessity for the installation of those bins, and my testimony would be the same as his.

Item 6 is to grade and tile manifold area in 1939, at a cost of $3,542. That expenditure will be made at Stations 2, 4, 5, 7, 8, 9 and 10. The installation has been completed prior to 1939 at Stations 3 and 6. In explaining the necessity for that item, I may refer to the photograph 624 designated as Exhibit 96 and explain that the manifold area so defined under Item 6 is that area between the cooling tower, designated as No. 12, and the main building, designated as No. 1, and in which the manifold piping is located, as designated by No. 11.

This area is subjected to constant precipitation, caused by spray falling from the cooling tower. In this area all control valves are located. These valves require frequent manipulation by the operators.

In the original construction of the plant, gravel walks were provided in this area. Those walks have disintegrated over the space of years that the system has been in operation, caused mainly by the frequent necessity of excavating to inspect and repair the piping in that area. This item provides for the installation of concrete block walks to supplant the original gravel walks. These concrete blocks may be removed when such excavation is needed or when trucks are driving in that area for any reason, and they may be replaced at later times.

The tiling is to lower the water table on this constantly wetted area, so that the operation and maintenance of this area will be facilitated.

The expenditure in 1939 for that item will be at all stations, with the exception of Stations 3 and 6, at which the installation has already been made.

Item 7 is entitled "Gravel Area Around Exhaust Stacks," with an expenditure in 1940 of $1,121. Mr. Powers included this item in his testimony, and my explanation of the necessity for this expenditure is the same as his.

Item 8 is entitled "Hard Surface Plant Roads," and shows expenditures in 1940, 1941 and 1942. In 1940 the

plant roads at Stations 8 and 10 will be hard surfaced or black topped, at a cost of $2,855. In 1941 the plant roads at Stations 5, 6 and 7 will be black topped, at a cost of $2,955. In 1942 the plant roads at Stations 2, 3 and 4 will be black topped, at a cost of $3,410. My testimony as to the necessity for those expenditures is the same as that of Mr. Powers.

Items 9 and 10 are now under construction. Authority for the expenditure shown in Item 11 has been granted and the material is under order.

My explanation of book cost of property retired is the same as the explanation given in connection with page 3 of Exhibit 97.

When we install a Transite roof we do not put it on over the iron. We take the iron off section by section, so the building is not open to the elements.

Cross-Examination Interposed by Mr. Slaff.

I stated with respect to Item 3 and page 4 the stations at which the main engine air filters are to be renewed,
625 and with respect to Item 4 I stated at what stations the main engine exhaust mufflers were to be installed.

Direct Examination by Mr. Hedrick Resumed.

Page 6 is entitled "Additional Capital Expenditure for Bunkhouse and Dwellings," and provides for the construction of eight four-room cottages at an expenditure of $33,576, in 1939. I believe Mr. Powers in his testimony dwelt at some length on the necessity of providing dwelling accommodations for certain employees in his operating personnel and also other employees connected with the pipeline and other departments which are situated in the field.

The Natural Gas Pipeline Company has a definite cottage building program under way. This program has been in effect for the past several years and will be extended through the year 1941.

As the stations were originally designed, planned and laid out, each station included a number of dwellings for the employees. Those dwellings are shown on Exhibit 96, under the figure 17. On that Exhibit 96 we show eight cottages. At present there are nine cottages at Station 6; that is, one additional cottage has been constructed at that point.

The original design and layout of the station included accommodations for main and auxiliary operating engineers who would be located at each station. They also provided one house for the pipeline superintendent. Shortly after the start of operations it was found that it was necessary, for the safe operation of this line, to house other personnel than the compressor station personnel at each station. That additional personnel included telephone linemen, meter men, pipeline foremen, truck drivers, welders, division clerks, as well as the repair foremen in the compressor station department and those operators heretofore named.

Shortly after this first cottage building program was undertaken, we started operation under the forty-hour work week. That automatically caused us to employ additional men as operators in the compressor station department and additional auxiliary and main engineers who were eligible for living accommodations at the station site. We were able to bear with this problem for a short time, due to the number of our employees who were then single. These men were housed in bunkhouses and secured accommodations at boarding houses situated on the plant site.

Our building program as now in effect and which will be extended in the future will provide additional living accommodations on the station site for those members of all departments who are eligible for houses and who are not now provided with houses. This item includes the construction of eight four-room cottages in 1939, those cottages to be constructed, one each, at Stations 2, 4 and 7, two at Station 10, three at Station 6, at a cost of $33,576.

It is very necessary in the operation, maintenance
626 and repair of station equipment that operators in the classes named be housed at the station, so that if an emergency occurred at one of the stations or on the pipeline, the employees may be more readily available than if they were in a town five or six or ten miles away or scattered around at places considerably removed from the pipeline.

I might add another point. It is not possible to house all of the employees that work for the pipeline department. The majority of the employees that are working for the pipeline department are what are termed mainte-

nance or laborers. Only the pipeline foremen, superintendents and key men are located in the houses at the station site, where such houses are available for those men. In the event of an emergency arising in the pipeline department, they depend largely on the personnel housed at the central location, that is, the compressor station, for immediate action, and compressor station men as well as pipeline men answer this emergency call. This fact increases the safety factor to an immeasurable degree in so far as operation of the pipeline is concerned, irrespective of the operation of the station.

It has happened quite frequently during the time Natural Gas Pipeline Company and Texoma have been operating that employees were called out at night or while they were off duty for an emergency in maintenance or repairs to the pipeline or compressor stations. It is almost a weekly occurrence in so far as the compressor station department is concerned, and it has also happened in the past on emergencies occurring on the pipeline away from the compressor station.

We have made a practice of interchanging employees between the pipeline department and the compressor department during the past three years. This interchange of employees has the prime motive of training all employees for emergency duty, as well as routine duty, in every department.

The next item is entitled "Construct Six 4 Room Cottages," at a cost of $25,182 in 1940, and represents the cost of two cottages to be constructed at each of Stations 3, 4 and 5.

The item entitled "Convert Three 7 Room Bunk Houses" at a cost of $5,700 in 1940 is the cost of converting a seven room bunk house into a private dwelling house at Stations 2, 5, and 9. Originally, as stated previously, we provided bunk houses and boarding house accommodations for those single employees. The labor turnover on this system has been low. The employees have married and raised families, and the remaining number of single men is very low. The result of this has been that the boarding houses and bunk houses are no longer useful for any appreciable number of employees. In many cases bunk houses were only occupied to the extent of one or two rooms. Inasmuch as we desired to house more employees at the station, and obviously when a single employee was

married he could no longer live at the bunk house, and must move to town, we converted bunk houses and boarding houses at six of the stations into private dwellings.

This item, as stated, in the amount of $5,700, is for the 627 conversion of the three remaining boarding houses and bunk houses into private dwellings at those stations stated in the year 1940, and that expenditure will be required and made in that year. There is some possibility that we might construct at least one of these conversions this year. Incidentally, we now have out bids for cottages in 1939.

The year 1941 will complete the cottage construction program. In that year we will construct thirteen 4 room cottages at a cost of $54,561; one cottage at each of Stations 3 and 9; two cottages at Station 7; and three cottages at each of Stations 5, 6 and 8.

Item 2 is entitled "Renew Domestic Water Tanks." The domestic water tank is a galvanized overhead tank, as shown by No. 15 on Exhibit 96. The life of this type of tank is limited, and a number of the tanks now installed have corroded badly on the bottom and sides. This tank is used to provide domestic water for cooking and drinking for the occupants of the cottages. It also supplies the necessary sewage water. One tank, situated at Station 5, has already corroded to the point where renewal has been necessary. A redwood tank was installed at this point as a replacement for the galvanized iron tank. The redwood tank is made of lumber similar to that used in the cooling tower. The condition of the tanks at other stations, as investigated and found, indicates that renewal of these tanks will be necessary in the years 1939 through 1942, if not sooner.

In 1939 we will renew the tanks at Stations 3 and 5. I believe I stated that the tank at Station 5 has already been renewed this year. In 1940 we will renew tanks at Stations 2, 4 and 10; in 1941, at Stations 6 and 7; in 1942 at Stations 8 and 9. These tanks will be renewed at the unit cost of $310 per tank in the years mentioned.

Item 3, entitled "Hard Surface Cottage Roads," is the black topping of the roads servicing the cottages in a manner similar to the roads servicing the plants and described in this exhibit previously. In 1940 we will hard surface or black top the road servicing the cottages at Stations 8 and 10, in the amount of $2,825. In 1941 we

will hard surface the road serving the cottages at Stations 5, 6 and 7, at a cost of $3,379. In 1942 we will hard surface the road servicing the cottages at Stations 2, 3 and 4, at a cost of $4,213.

Item 4 provides for the construction of concrete floors in the cottage garage. The original installation in the garages as constructed was of crushed rock or gravel in the cottage area. The plant garages, or those garages situated in the area immediately surrounding the compressor station proper, such as the garage shown by the numeral 5 on Exhibit 96, are constructed with a concrete floor. Concrete floors have been much more satisfactory than rock or gravel floors as used in the employees' garages.

The company regulations require that the garage be kept in a neat and orderly condition, and it is impossible to keep the garages in that condition with crushed rock or gravel floors when the employees drive their cars in covered with mud and knock it off in there, etc. The condition of the garage floors at the present time is not good. They are rutted, and the gravel or crushed rock has a very high
628 percentage of mud intermingled with it.

Item 5 is for hard surfacing tennis courts which have been provided for the employees at several stations. There are seven tennis courts now installed. Since the building of these courts the employees have made frequent use of them. We have frequent petitions sent into the Chicago office for improving these recreational facilities. We have had petitions for lighting the courts, and many petitions for hardsurfacing the courts because it is not possible to keep up a good playing surface at all times with a dirt or improvised court.

The cost of hard surfacing these courts which will be hard surfaced is $1,725 in 1940 at Stations 2, 3 and 4; $1,150 at Stations 5 and 7; and $1,150 for tennis courts located at Stations 9 and 10.

Item 6 is for the construction of additional garage stalls. The construction of garage stalls parallels the construction of additional cottages. Each employee renting a company cottage is entitled to a company garage to house his personal car. In addition, as additional employees are housed at the station there will be other company cars to provide garages for.

Item 7 is for the installation of additional septic tanks and sewage that will be necessary as the housing program progresses. The present septic tanks in use at each station

are designed primarily for the original number of cottages located at each station, and as we add cottages at each station additional sewage disposal facilities must be added. Many of the present tanks are now overloaded at those stations where part of the building program has gone forward.

Item 8 is for the improvement of the lighting facilities for the cottage area at all stations, and is now under construction.

Item 9 provides for the construction of additional playground facilities at Station 4. This is also under construction at the present time.

I will explain the situation with reference to tennis courts and playground facilities. No small part of my duties is connected with direction of personnel, and in pursuance of those duties I come upon many problems concerning the welfare of the employees, individually and collectively. The employees desire to secure accommodations at the station, and after securing such accommodations they desire recreational facilities of one kind or another.

Our pipe line, as stated before, traverses a rather sparsely settled area. By that I mean that there are not usually large towns situated close by the station sites. These people engaged in either the operation of the pipeline or the compressor station equipment need recreational facilities of some kind or another. It has been the company's policy to provide such recreational facilities as it felt it could justly do. In my own opinion, I believe such an expenditure as has been made to date has been justified in many ways and has paid big dividends in so
629 far as satisfaction and contentment of the employees are concerned. It is very doubtful in my mind that we could satisfy the employees to the degree that they are satisfied without the provision of such facilities.

To date we have not had any serious labor troubles. I like to believe that the major reason we haven't had such labor trouble is because the management has cooperated to the degree that it has in providing facilities for the employees as requested, and when those employees have shown a real interest in securing such facilities. I believe that the facilities which we provide are really a part of the employees' compensation, although perhaps rather intangible.

Item 10 is for the installation of additional drainage at

Stations 2 and 6. Work requests have been issued for these jobs, and material has been ordered.

My explanation of the retirement at the bottom of page 6 is the same as the explanation of the retirements on page 3 of this exhibit.

(At this point counsel for defendants offered EXHIBIT 97, and it was received in evidence over the objection of counsel for each of the Commissions, to whom an exception was allowed.

Counsel for defendants then presented a document described as "Natural Gas Pipeline Company of America, Operation and Maintenance, Compressor Station Department, Witness, W. H. Davidson." At the direction of the Examiner, the document was marked Exhibit 98 for identification.)

I prepared Exhibit 98.

Line 1 on the first page of this exhibit shows expenditures for operating labor from 1932 to 1954. The expenditures from 1932 to 1938 are the amounts in dollars actually expended for operating labor during those years. That is also true as to lines 1 to 6, inclusive, and lines 8 to 15, inclusive, except that lines 8 to 15 represent items for maintenance. Those are the actual expenditures for the items as listed by lines for the years 1932 to 1938.

The average as shown for the years 1936 to 1938, in the amount of $259,627, is an average of actual expenditures for those years, but it includes the presently prevailing wage scale in only two of those years, that is, 1937 and 1938. In 1939 the volume of gas to be transported by the Natural Gas Pipeline Company will be slightly in excess of those volumes pumped and delivered in 1938, and a slight increase in the cost of operating labor for the years 1939 to 1951, inclusive, provides for that slight increase in gas deliveries.

The difference in cost in 1938 and what we say it will cost in 1939 amounts to approximately $165 per year, per station.

On operating material, which is line 2, the costs for each of the years 1939 to 1951, inclusive, are slightly lower than the 1936-1938 average and somewhat higher than the 630 1938 average. The cost for the operating materials that will be necessary in 1939 is $135 less than the average for the years 1936 to 1938, in the amount of $49,042. That difference is so slight that I believe the expenditure could be termed as very nearly the average.

It is my judgment that those amounts to be expended in 1939 will also be expended in the years 1940 to 1951, inclusive. This applies to lines 1 and 2 for operating labor and operating material.

On line 3 I show $300 per year from 1939 to 1952 on account of damages. The company is liable for damages for a number of different things, including damages accruing from waste drainage and loss of cattle due to drinking the fluid from the septic tanks. It is liable to the general public for any condition which might exist because of its operations that may be hazardous. It is liable for fires and explosions that might cause loss on adjoining properties. There have been a number of damage settlements since this portion of the exhibit was prepared. Damages accruing for 1939 are in excess of $560. None of this was for fire or explosion damage. The damage settlements to date in the current year include payment for a number of sheep which were alleged to have been killed at Station 8 from drinking effluent from the septic tank, and also include a settlement, I believe, for a drainage problem.

It is probably true that these small annual figures would not begin to cover or take care of any damage from fire or explosion. However, what I had particularly in mind, although I imagine the record will be a little confusing on that point, were damages from fires occasioned by burning off weeds and grass on the plant site, when I was thinking of fires. We have a large area on the plant site upon which there are no facilities, and we try to keep a large part of the vegetation cut down, but in the fall of the year we burn it off. At several stations there are buildings right up against the property fencing, although we have not experienced any damages from that cause that I recollect. There might be damages from that cause.

We have not made any provision for large items of damage that might occur. As to whether we have any situations existing at the compressor stations which might result in heavy and serious damages to persons or property, we have a situation that was called to our attention last winter, although it has been prevalent for a number of years. That is a situation that exists at each of stations Nos. 4 and 5. Those two stations are situated north of a main traveled highway, adjacent to the station, in about the same position as the highway noted on Exhibit 96. The prevailing winds at those two stations are such that they blow the spray from the cooling tower out over the road-

way, and it presents a condition that is hazardous to people driving by the station.

It freezes on the surface of the road and makes it slick. It also, depending upon the atmospheric conditions, creates a fog which obstructs the vision of the driver of the automobile. This matter has been discussed in our office in Chicago, and I have been instructed to place signs at some distance at either side of the station site where this
631 condition exists, and in addition to the signs we place men out there with flags or lanterns, as the case might be, to flag and caution automobile drivers. We do that when it is frozen and also when the fog is real bad. This condition does not prevail continuously. It prevails at certain atmospheric conditions, naturally, and it prevails when the wind is in the north.

Item 4 includes the expenses for myself and other executives of the Chicago office who may have occasion to go out in the field to inspect the compressor stations, and it also includes the expenses of any engineers sent out for special investigation of any particular problem.

Item 5 is the cost of operating fuel for operating the main compressor and auxiliary engines at each compressor station. That yearly amount for the years 1939 to 1951 is somewhat less than the 1936-1938 average. We have used the fuel consumption as in effect the latter part of 1938. In 1938 we effected certain fuel economy in the operation of the main engine equipment, particularly, and we believe and hope that we may continue operation at this low fuel consumption.

Item 6 is for lubricating oils and greases, which are necessary for the operation of all the compressor stations' operating equipment, particularly the main engines and auxiliary engines. The amounts from 1939 on are a little less than the 1936-1938 average.

Items 8 to 15, under the sub-head "Maintenance," are explained in more detail on pages 2 to 8 of Exhibit 98.

Page 9, entitled "Bunk House and Dwellings, Labor and Material," includes the necessary maintenance, labor and material for the bunk house and dwellings for the years 1939 to 1954, inclusive, and includes painting and repairs necessary to the cottages and also the necessary maintenance to the sidewalks, grounds, piping and other appurtenances necessary to the cottages. The amounts shown on this page are not included in the general recapitulation

on the first page of Exhibit 98, and will be in addition to that recapitulation.

I used prices as of June 1, 1939, for both labor and materials in figuring the costs of the various items making up this exhibit.

It is my considered judgment, based on my experience and my knowledge of the property of Natural Gas Pipeline Company and the demands upon that equipment in the course of the company's operations, that at prevailing costs of labor and materials as of June 1, 1939, the amounts set forth in Exhibit 98 will be expended by the company in the operation of its business and the maintenance of its property on the respective dates stated in this exhibit.

(At this point counsel for defendants offered EXHIBIT 98 in evidence.)

632 *Cross-Examination Interposed by Mr. Slaff.*

In entering retirement expense on the books of the company, we consult with the accounting department of the company. I have been instructed by the accounting department that such expense is a proper maintenance charge.

Direct Examination by Mr. Hedrick Resumed.

As shown on this exhibit, retirement expense is that expense incurred while making the retirement of any particular item that is retired, that is, labor expense. It is the cost of taking that material out of service, and it is my testimony that that particular expense will be incurred in the years shown in this exhibit. If it is a proper bookkeeping entry as retirement expense, it is my judgment that the expenditure should be included as I have included it here, as a bookkeeping matter.

Cross-Examination Interposed by Mr. Slaff.

Answering your question as to what distinction I make between labor connected with the retirement expense and materials with retirement expense, there are no material items included in retirement expense. They are all labor items. I make the distinction because there is no material used in making the retirement. We retire materials from

service in the course of years. I believe, if I am not mistaken, that the retirement of materials is shown in Exhibit 97 under the heading "Salvage and Retirements." I am not familiar with the bookkeeping procedure as to what account the materials retired are charged to.

Cross-Examination Interposed by Mr. Booth.

As to whether I had anything to do with the determination of whether or not the items included in this exhibit are properly to be treated as operating and maintenance expense from an accounting point of view, that the accounting department sets forth a procedure to be followed by all operating departments. We follow that procedure as set forth. Exhibit 98 follows exactly the procedure followed in the everyday run of the business of the company. I received those instructions from the accounting department on the day I started to work for this company, which I believe was in March of 1931. I did not receive any instructions from them in connection with the preparation of this exhibit.

(At this point EXHIBIT 98 was received in evidence over the objection of counsel for each of the Commissions, to whom an exception was allowed. Motion by Commission counsel to strike witness' testimony denied.)

Cross-Examination by Mr. Slaff.

I testified in one other case for Natural Gas Pipeline Company. That case had to do with a lawsuit brought by a farmer residing across the road from our Joliet regulator station. It was a damage suit. (Renewal of motion by Commission counsel to strike Exhibit 98. Company counsel limits purpose of exhibit and Examiner reserved ruling on motion.)

633 R. M. BUSSARD, a witness for defendants, recalled, testified as follows:

Direct Examination by Mr. Morgan.

(July 29, 1939)

When I was testifying on Thursday morning, counsel requested the Examiner to allow my withdrawal from the witness stand in order that I might check the method which I

had used in the computation of the composite or average back pressure curves of the several groups of wells located on the areas respectively set forth on Exhibit 90. I have made such a check.

I have considered the matter both personally and with those whom I consulted concerning the engineering problems involved in this study to determine whether or not there was any error in the method of computation. We have concluded that there is no reason to change our method of computation, and I am not bringing in any new change as a part of my testimony.

However, in the course of checking these curves and the charts on which these curves appear in Exhibit 89, we did discover a few errors which I think we should point out at this time.

The mistakes that I want to discuss this morning first are on the fifth page of Exhibit 89, which is the back pressure data chart for well group No. 3-A. In order to locate the points of error, I will speak of the horizontal scale in terms of the cycles from the left hand edge of the sheet. Starting at the left hand edge and moving to the right to the end of the second cycle on the horizontal scale, we find the figure "5" and then above it a "1" and a "0". The little figure above the "5" appears to be "10." It should be "1.0." The drafting room was in error there.

To locate the next correction I wish to make on this sheet, progress to the right to the end of the succeeding cycle on the scale, at which we find the figure "1.00." The drafting room made an error there, and that figure should be "10."

I would like to say that the mistakes on the chart have not affected our calculations. In fact, they did not enter into our calculations at all.

Another mistake which I find is on page 8 of Exhibit 89, which is the page for well group No. 5. The charting of the composite line on this sheet is in error at the pressure factor point of 15,000. The composite line is located at 1.3 as drawn on the chart for the value 15,000, whereas it should be located at a Q quantity of 1.03. Again we have an error that occurred in the drafting room at the time the chart was constructed. The error does not occur in our calculations. We have prepared a revised page for this particular group, if you desire it.

634 (At this point the corrected sheet for Group No. 5, at the direction of the Examiner, was marked Exhibit

99. EXHIBIT 99 was offered and received in evidence without objection.)

The document which is marked Exhibit 99 is the corrected chart on well group No. 5 appearing in page 8 of Exhibit 89.

While I was on the stand the Examiner asked some questions concerning some symbols appearing on page 1 of Exhibit 89. I am prepared to explain those symbols.

When I was explaining this section of page 1 of Exhibit 89 called "Calculation of Back Pressures at the Sand," I was asked for the meaning of the symbol P_2^2. P_2 is a symbol which was obtained from the Bureau of Mines publication RI 2929, and, as defined in that publication on page 2, is the absolute pressure at the wellhead in pounds per square inch. Therefore, the symbol P_2^2 on page 1 of Exhibit 89 is P_2 multiplied by itself, or the square of the wellhead absolute pressure.

RI 2929 is not the same as Monograph No. 7. It happens that the Bureau of Mines made their first report concerning their back pressure work in two reports of investigation, RI 2929 and RI 2930. Both are dated May, 1929.

All of the other symbols in that portion of page 1, which is called "Calculation of Back Pressures at the Sand," are defined in this report of investigation 2929 on page 2, and the symbols are also defined in Monograph No. 7 on page 141.

I here read into the record an extract from RI 2929, at page 2, showing the definitions of the various terms:

"Method of Computing Pressures at the Sand in a Gas Well.

Nomenclature.

"The following nomenclature has been used in the formulas and in explaining the methods of computing pressures at the sand in a gas well from volume and pressure observations at the wellhead:

P_2=Absolute pressure at the well head, pounds per square inch.

P_1=Absolute pressure at the well head plus the pressure drop due to friction, pounds per square inch.

P_s=Absolute pressure at the sand, pounds per square inch. (Absolute pressure at the well head, plus the pressure drop due to friction, plus the pressure due to the weight of column of gas.)

P_f=Absolute formation or "shut-in" pressure in the

sand, pounds per square inch (absolute pressure at the well head when shut in, plus the pressure due to the weight of the column of gas).

635 Q=Rate of flow, cubic feet per 24 hours, at 14.4 pounds per square inch and 60 degrees F., assuming an average flowing temperature of 80 degrees F. in the producing "string" of casing or tubing. (It is here assumed that 80 degrees F. represents an average temperature in the producing string, and the actual variation from this assumed condition will not create any considerable error in the computation of pressures.)

d=Internal diameter of the producing string, inches.

G=Specific gravity of gas (air=1).

L=Length of pipe, feet.

R=Combined factor selected from Weymouth's formula 4 for flow of gas through pipe=square root of $P_1^2-P_2^2$ (See P. 18).

e=Base of Napierian logarithms=2.71828.

F=Correction factor for density due to pressure variation in the flowing column of gas (see p. 21)."

Questions by the Examiner.

I think I can give a general statement about the formula in the upper lefthand portion of page 1 of Exhibit 89 which I decided not to use.

These expressions to which the Examiner refers have to do with the calculations for the determination of the weight of the moving column of gas and also have to do with the calculations for the determination of the pressure effect of friction in the string of pipe. I left the impression from my answers that I did not make these corrections and that if I had made the corrections the expressions called for would have resulted in very minor errors. I did not express myself very clearly on that point. What I intended to say was that I did not go through the long calculations. I did not do all of the mathematical work involved in solving the formulae, and the reason I did not do that was because there had been developed certain tables which, in effect, solve these formulae and permit us to materially reduce the work involved in determining the correction for the weight of a column of gas and the correction for the friction effect.

At the time this formula on page 1 of Exhibit 89 was made, only R. I. 2929 was in publication, and our produc-

tion engineers who made that form for our regular use made it in that particular manner following the symbols and formulae indicated in R. I. 2929. At a later date these tables that facilitate our work were developed, and at the time Monograph No. 7 was published in late 1935, I think, the tables were incorporated in the monograph and are shown therein. In other words, we have been using a calculation sheet such as this since late in 1931, when this particular formula on page 1 of Exhibit 89 was prepared by one of our production engineers.

636 R. I. 2930 was also in publication but had no particular bearing on this. The No. 2929 relates to computing the pressure at the sand in a gas well and is called Part 1. R. I. 2930 is a fundamental relation for gauging gas well capacities, and is Part 2 of the publication then made.

As to what I mean when I say "correction for the weight of the column of gas," perhaps if I say why we do that it will explain. We desire to determine the pressure conditions at the bottom of the well, the bottom hole condition, as we call it, but our gauges used in recording the test data are located at the head of the well up at the ground surface. So to get from the ground surface record to the bottom hole pressure, we must add to the ground surface record the weight of the column of gas. I think there was nothing other than just dead weight that I was taking into consideration; there was nothing like inertia.

Direct Examination by Mr. Morgan.

When I was withdrawn from the stand, counsel was about to ask me some questions concerning one of the charts shown in Exhibit 91, having to do with the rock pressures of wells belonging to Texoma in the several groups shown on Exhibit 90 and with the projected weighted average pressures in those respective groups of wells.

Counsel refers to the rock pressure curves dealing with wells in Group 1 and rock pressure curves dealing with the wells in Group 8, pointing out that my estimated future curve for the wells in Group 1 approaches the righthand side of the chart at a point which I have taken as 25 pounds well head gauge at the end of 1954, and that the same line on the page of the chart representing Group 8 has a different course; that the curve in Group 1 is represented by a line that is comparatively straight when compared with

the course of the curve shown in Group 8, where the line takes more the course of the righthand half of a rainbow. I am asked to explain how I account for the difference in the behaviors of the pressures as I conceive them to be in those two groups during the period from January 1, 1939, to the end of 1954.

The difference in appearance of the two lines comes about primarily from the fact that the weighted average rock pressure in Group 1, as of January 1, 1939, was materially lower than the weighted average rock pressure in Group 8 as of January 1st, 1939. In other words, the weighted average pressure of the area to which I have referred as Group 1, as of January 1, 1939, was approximately at 270 pounds, and the weighted average pressure prevailing in Group 8 as of the same date, January 1, 1939, was approximately 384 pounds.

I am asked to explain the circumstance that the pressures in an area where they have already been reduced to 270 pounds on January 1, 1939, will so decline as to be equalized with the pressures in Group 8, which I found to be 384 pounds on January 1, 1939, by the end of 1954, and to explain what it is that will cause those lines to take such different courses over that same period of time.

637 The lines necessarily take the different courses because of the difference in total rock pressure decline that will occur in the respective groups. Group 1 is close to an area quite highly developed and from which there has been a considerable quantity of production. Necessarily, the weighted average pressure in Group 1 has been materially affected by this production and has declined materially to this 270 pounds average that the chart shows. On the other hand, the area represented by Group 8 has had very little development in it. The company has very few wells there, and, in fact, the other companies have very few wells there.

In the future there will be more wells, and as there are more wells drilled in area No. 8, necessarily the rock pressure is going to decline more rapidly because of the greater quantity of gas that is being taken out of it. This general trend of distribution of production is not confined to Group 8 particularly, but it is something that is going to happen in the field as a whole. We are going to see increasing amounts of drilling in areas not now highly developed. As the production spreads it is going to have its effect upon the rock pressure and we are going to see an accelerated

decline, because there will be not only the general drainage effect throughout the field, but there will be this increased concentration of production, or, rather, it is a spread of production which increases the tendency of the area to decline in pressure.

It is our opinion that as this production spreads, the field begins to become more and more uniform as to pressure conditions, and eventually, when the gas is taken from the field, there has to result a uniform pressure condition.

As the production spreads throughout the field and reduces the rock pressure in what are now the higher pressure areas, there necessarily results a lesser drainage into that low pressure area and into Group 1. Over a period of time it must occur that the repressuring effect into Group 1 will be less than it has been.

Our schedule contemplates drilling one more well in Group 1 and an additional nine wells in Group 8 on Texoma's property. There will be a number of other wells drilled in that area by owners of other leases, because that is a comparatively undeveloped area. When these additional wells are drilled on Texoma's property and additional wells are drilled on the property of others, the pressure decline in that area will be accelerated as compared with what it has been in the past. Obviously, the pressure decline is going to increase, because the decline is dependent on the drainage from the area and the quantity of production from the area, and the more you produce the more the pressure decline will increase. That pressure will go down at a faster rate as compared with what it has declined during the past years.

In our study as to the future capital requirements of Texoma we have used these weighted average rock
638 pressures indicated by the estimated future line in conjunction with our back pressure chart work, in that, knowing the rock pressure from time to time, we can refer to the various group back pressure charts and determine the quantity of open flow that will exist at the corresponding date in the several groups.

The open flow for the wells to be drilled in a particular area in a particular year is determined by taking the rock pressure in that particular year and group and going to the composite back pressure line for the group and determining the open flow from this composite line and then, of course, assigning that open flow to the wells in the group in the year.

By the use of the two curves, the curves shown on Exhibit 91 and on Exhibit 89, we are able to ascertain how long the present wells of Texoma would produce a sufficient quantity of gas to meet the requirements of the Texoma portion of the pipeline outlet. By using the rock pressure data in conjunction with the back pressure data we can tell how much a well in the particular group would produce, and I speak of an average well in the group, and thereby build up the total production for the company and relate that to Texoma's portion of the market demand of Natural Gas Pipeline Company.

As to the other uses which I have made of the facts and principles developed by these curves and the calculations which these curves represent in the economic study in which I have been engaged, the rock pressure data and the back pressure data permit us to make a number of rather important determinations by finding the quantity of gas to be produced in a given year. In a given year we can determine how much gas the booster stations in that particular area are going to handle, and thereby with the rock pressure conditions and the volumes to be handled we know how much horsepower we have to have. We know when we have to put the horsepower in. We know where we have to put the horsepower.

Also we can determine the size of the gathering line that has to be laid from the new well to the existing gathering system. We can determine such things as we need in Mr. G. M. Davidson's estimate of the gasoline plant revenue in that we can find the quantity of gas to be produced in Moore County in a given year and in the other counties, and inasmuch as there is a difference in the gasoline recovery, we are thereby enabled to get a more accurate picture of the quantity of gasoline recovery.

As to whether I made use of the same principles in determining the future drilling requirements of Texoma in order to have available this full quota of the pipeline's market outlet during the latter period of the project's life, I will say that inasmuch as we can by use of the rock pressure and back pressure data determine the quantity that the wells can produce, we could determine what well drilling would be required to meet Texoma's share of the full market requirements of the pipeline company.

As we proceeded from year to year in our study, we always saw to it that the production did not exceed 25% of the open flow, because there is a law in the State of Texas

that prohibits production in excess of 25% of the daily open flow quantity of the well. That is a statutory requirement, or limitation.

I have already stated that in determining the num-
639 ber of wells to be drilled I collaborated with Mr. J. G. Dickinson, the general superintendent of production of Texoma Natural Gas Company. In this study I have undertaken to determine, in consultation with Mr. Dickinson and others, the number of wells that Texoma will drill in the future, the time when it will drill those wells, and the location of those wells as they are drilled.

The future well drilling program and the location of the wells has been a matter of collaboration, and Mr. Dickinson and I have worked quite closely on that together. In distributing these wells from year to year and in the various groups, we have to take into consideration the particular area, and we have to consider the contractual obligations of our leaseholds and of our consolidation agreements. We have also to consider the need for protection against outside drainage and against drainage by others close by the areas in which we have leaseholds. It is also necessary that we take into consideration the management's direction that we so distribute the cost of drilling and the other costs contingent upon the drilling throughout the future of the company that there may be no undue burden imposed from year to year upon the revenues of the company, and, necessarily, we also want to avoid deferring drilling until just that very day in which we get into a shortage of open flow and then have to try to drill our wells all at once in order to maintain our market position. The result of this work that Mr. Dickinson and I have prepared together is a well drilling program.

These considerations of lease requirements and drainage protection, and the policy of the company in distributing the burden of its drilling program over the whole life of the field instead of deferring it until the production must be had in order to meet the immediate situation—or, to state it otherwise, conducting its drilling operations on a hand to mouth basis—govern the spread of the drilling throughout the years, and not the total number of wells to be drilled. We have arrived at the total number of wells to be drilled by the application of the engineering production principles which are illustrated by Exhibits 89 and 91, together with the cost of doing the drilling and the revenues that can be obtained therefrom. I have prepared a tab-

ulation setting out the number of wells to be drilled and the schedule of the drilling.

(At this point counsel for defendants presented a document described as "Texoma Natural Gas Company; Future Wells, Gathering System and Booster Station Program; Witness, R. M. Bussard." At the direction of the Examiner, the document was marked Exhibit 100 for identification.)

That tabulation is the first sheet in Exhibit 100. Along the lefthand side of this page are the words "Group No. 1," and below the figure "1" some other figures; then, "Total Carson-Gray" and some other figures, and then "Total Moore" and "Grand Total." Confining ourselves to that portion of the page, which is approximately the upper half of the page, those numbers refer to the Texoma well groups that we have used in our Exhibits 89, 90 and 91. When I speak of Group No. 1 on this exhibit, I am talking about that pink area over in the western part of Gray County, as shown on Exhibit 90.

640 The figures in the column headed "1938" are the number of wells owned by Texoma in the several well groups as of December 31, 1938. With one exception, those wells were all then completed and either connected with our pipeline or about to be connected with the pipeline. As of the date given, these wells were in production.

To illustrate the figures in the column headed "1939," I will take the first figure in the column which is the number "2." That is set opposite Group No. 2, so that there is an indication that we intend to drill two wells in this particular well group in 1939; in fact, those wells may have been drilled at this time. I am not just clear in my memory as to that. I take the first of January, 1939, as the dividing point, for reasons already reflected by the record.

The second figure "2" is to the effect that there will be two wells drilled by Texoma in Group 3-A in the year 1939. Next we find that there will be one well drilled in Group 3-B. Moving on down, the figure "5" opposite "Total Carson-Gray" simply indicates that there will be a total of five wells drilled in the Carson-Gray County area during 1939 by Texoma.

We move on down to the figure "2" opposite Group No. 7, which means that there will be two wells drilled by Texoma in Group No. 7 in 1939. Similarly, the numbers below relate to the number of wells that will be drilled in each one of the groups during 1939. Then we come to the number

"17" opposite "Total Moore," and that means that there will be a total of 17 wells drilled by Texoma in 1939 in Moore County.

Finally we see the number "22," and there we have the gross number of wells to be added to production during 1939 by Texoma.

If I went through it in detail, my explanation of the figures under the captions of 1940, 1941, 1942, and so on across the page, through the year 1951, would be the same.

In effect we have assigned Group 6 to Carson County; but it is actually in Hutchinson County. It is a terminology on our part. We just refer to the area east of Fritch station as being Carson-Gray County, and this will apply also to Group 5. Group 5's boundary lines are up in Hutchinson County a little ways.

The totals show that there are 22 wells to be drilled in 1939, 20 to be added in 1940, 20 in 1941 and 20 each year on through the year 1944. That indicates the total number of wells to be drilled each year during the period 1939 to 1951, inclusive. Just one well will be drilled in 1951, 9 in 1950, and 12 in 1949. We have determined that there will be a total of 215 wells added to Texoma's production after the first of 1939, which, including the wells already drilled and on production, will make a total of 350 wells.

The lower half of this same page of Exhibit 100 is an accumulation in that the starting figure at the end of 1938 has added to it the subsequent yearly drilling, and this
641 sheet simply shows how many wells are on hand at the beginning of each year, and finally totals 350 wells.

In getting the gas into the pipeline from the 215 wells which are to be drilled after January 1, 1939, we will have to lay lateral lines in order to connect those wells to the existing system, and when the rock pressure becomes inadequate to cause the gas to flow to Fritch and arrive there at an adequate pressure, we will have to install booster stations in the field.

We have made a study as to the lateral line and booster station requirements in connection with these 215 wells that Texoma will add to its production after January 1, 1939, and the second sheet of Exhibit 100 contains a summary of the lateral line construction required by the well drilling program.

The first column, of course, speaks for itself and shows the years during which the wells will be drilled, as shown in the schedule on the first sheet of this exhibit about which

I have been testifying. The second column shows the same figures as those reflected on the first sheet as to the number of wells to be drilled.

There are five columns immediately to the right of this second column under the general caption "Miles and Size of Line." The figures at the head of the first four columns in this section are the diameters of the lines that we anticipate we will have to lay to connect the future well drilling to the existing gathering system.

Taking the column headed "Four-inch" and going downward, we find the total amount of four-inch pipeline that would have to be laid each year in the future to connect the future well drilling to this system. Similarly, under the columns headed "Six-inch," "Eight-inch," and "Ten-inch," we find the annual quantities of additional gathering lines to be required. The final column in this particular section is headed "Total" and is the gross mileage added by the capital expenditure of Texoma for well lines each year that the drilling program continues, and down below is a summation of the total amount of mileage laid throughout the drilling period.

We expect to lay 106.61 miles of four-inch gathering line from the first of 1939 to the end of 1951. The symbol "R" means that we are taking one section of line out by retirement. This is because we had to make a shift on account of our booster station development and the line was not needed any longer. The total column carries only the net for the year.

We expect to lay 67.8 miles of six-inch line in the future well drilling activities, 17.89 miles of eight-inch line, and 1.68 miles of ten-inch line.

642 Coming back to that letter "R" at the bottom of the column under the four-inch, I called attention to the fact that opposite the year 1951, in the column headed "Total," we show the net amount of pipe added to the system during the year. I did not make a specific reference to reclaim. I just wanted to call attention to the fact that the reclaim was not included in the mileage shown on this sheet.

When I speak of reclaim, I mean we take the line up out of the ground and stock the pipe. It is not necessarily retired from the plant account as long as the pipe is taken in stock. It would go out of plant in service and into materials and supplies if the company retained ownership.

To the right of the group about which I have been testifying there are some figures under the general caption "Change Connections." "Change Connections" relates to some work in addition to the laying of the well lines and the connecting of these lines to the existing system.

As we go into the future and construct booster stations, we will have to make some changes in the lines from time to time, and we will be disconnecting a four-inch line from, let us say, a ten-inch line and reconnecting that four-inch line to another line, possibly a line which has been laid for the purpose of an intake line into a booster station. These quantities in this particular section called "Change Connections" simply mean that we will cut loose so many connections of a certain size in a certain year and reconnect the line to another part of the gathering system.

The figures as to the quantities of pipe taken up and retired from plant account and put in stock or used somewhere else will all be developed through another witness.

Over on the right hand side of sheet No. 2 is a double column of figures under the general caption "Well Connections, Meter and Regulator Setting, Etc.," with the subheadings of "Four-inch" and "Six-inch." The future well drilling will not produce wells of uniform size. We commonly use a four-inch meter piping and six-inch meter piping, depending upon the size of the well. These two columns to which I have referred simply indicate the size of meter piping that will be required for a certain number of wells in the different years, and they are just an indication to the man who has to make the cost estimate that he should provide in his cost estimate for these numbers of the various sizes shown.

We build gathering lines of different diameters out to different wells in the field. The diameter of the gathering line depends upon the quantity of gas the line has to carry, the length the line will be, and the pressure conditions under which that line will operate. The variations of those three factors are the determinations of the diameter of the lines shown in our gathering system construction program.

We have made a very careful study of the quantities and sizes of lines that will be required to connect these 215 wells with the gathering system. In fact, that is one of the uses of the correlation of the rock pressure data and the back pressure charts.

In the pages immediately following sheet No. 2 of
643 this exhibit we have shown the details of the gathering system construction for each of the several years of the drilling program. Pages numbered 1, 2, 3, 4, 5, 6, 7, and on to 12, inclusive, are devoted to such details. These detail sheets are self-explanatory and can be readily correlated with sheet No. 2. They are simply the details of each of the years and the totals for each year as brought forth on sheet No. 2 of this exhibit in the recap.

On page 1 of these detail sheets there is a note which reads "This assumes the Pythian property is purchased." The word "purchased" is somewhat erroneous, and should be "acquired." By this particular note I mean to refer to a proposition the company has up with the Phillips Petroleum Company, whereby Texoma will trade a well and some lease for a well and lease of the Phillips. The name of this particular lease and well that we expect to get from the Phillips is called the Pythian.

Another element in that trade is the gathering line between the well and our existing 24 inch trunk. That happens to be some 3.8 miles, as indicated on this sheet, and included in our negotiations with the Phillips is the item of purchasing that quantity of gathering line. That exchange of properties has been actually effected. The transfer was made after these figures were compiled, but it is now effective and that qualification is no longer necessary.

Questions by the Examiner.

The Phillips well was already connected to our lines because we have an agreement with the Phillips Petroleum Company for the exchange of natural gas. This was a line through which they were bringing gas to us under their exchange agreement. One of the wells that Phillips Petroleum Company used to deliver gas to us under their exchange agreement has now been acquired by Texoma. In other words, they were swapping gas for a while and now they have swapped wells.

Direct Examination Resumed by Mr. Morgan.

The results of our analysis and study of the booster station requirements are set forth starting with page 13 of the exhibit. Page 13 is a summary of the booster station program. The upper third of the page relates to the number of stations that will be installed in Moore County and

to the number of stations that will be installed in the other counties in which Texoma produces.

The figures might be explained by taking the year 1946 and finding the figure 19 opposite Moore County. As of January 1, 1946, we will have booster station power installed at 19 different points in Moore County, according to our calculations and estimates. They will be installed in 1945. We chose the first of the year as a very definite breaking point, for simplicity of presentation.

The figure to the right of the figure "19" is "30" and that figure "30" indicates that as of January 1, 1947, there will be booster station power installed at 30 points in Moore County. This means a total of 30 points, of which 11 will have been constructed during the preceding year. By this I mean that there will be 11 different additional booster station locations brought into the
644 Texoma field property during 1946. When I say location, I mean the buildings, engines and all of the piping and everything else that goes with that station, a completed, ready-to-operate station.

Questions by the Examiner.

These are not what would be called centrally located booster stations. They are more in the nature of decentralized stations. I believe Mr. Brown said there was a possibility of adopting a decentralized program, and this particular program we have gotten up here is more in the nature of a decentralized program. There are some instances where there are stations which have on their intake only one well; but they would be few in number. The number of wells on the intake varies from station to station.

Direct Examination by Mr. Morgan.

On page 13, moving out to the last column under the year 1954 are the numbers 30, 30 and 60. The first 30 means that there are 30 booster stations installed in Moore County as of the first of 1954. The second 30 means that there are 30 booster stations in Carson, Gray and Hutchinson Counties. The total installation as of the first of 1954 will be 60 stations. There will be 60 locations at which booster stations will be built as of that date, and there will be 60 booster stations handling the production of 350 wells as of the first of January, 1954.

There is another group of figures under the caption "Number Units in Use, Moore County, Carson, Gray and Hutchinson Counties," and so on, immediately below the group of figures about which I have just been testifying. The figures under the caption "Number of Units in Use" tell us how many engines are in use in the several stations that have been built as of January 1st of the years under which the numbers appear. For illustration, under the caption "Carson, Gray and Hutchinson Counties," for the year 1939 there is a total of one. That means one booster station engine is in use now. It is in that group of Carson, Gray and Hutchinson Counties. By the end of that year or the beginning of 1940, we will not have to add any engines in Carson, Gray and Hutchinson Counties, and that one unit which is in use as of the first of 1939 is still the only unit in use as of the first of 1940. We will have to put two more engines into operation during the year 1940; and I arrive at that figure by seeing that under the year 1941, as of January 1st, we will have three engines in use.

There are no booster stations provided for in Moore County, or engines provided for use in booster stations in Moore County, prior to 1946. That difference in requirements is a reflection of the pressure conditions existing in the various areas. The pressures in Moore County are sufficiently high that it is not until during 1945 that our study shows any need to install any booster station horse power in Moore County. We are providing for these booster stations and this booster station investment as it is required during the future history of the project.

There is a third group of figures opposite the lines under the caption "Horse Power in Use" on that same page
645 13 of Exhibit 100. We have just been talking about the number of units in use, and inasmuch as the size of the engine that we contemplate is a 40 horse power engine, we multiply the number of units by 40 horse power per unit to represent the horse power in use at the dates shown, and that simply refers to the aggregate horse power of the engines which are shown in the group of figures immediately above it.

As of the first of 1954 our study shows that Moore County will require 126 units, containing a total of 5,040 horse power. Our studies further show that for the same date, and for Carson, Gray and Hutchinson Counties, we

will have to have 81 units in service. These 81 units amount to 3,240 horse power.

However, Texoma as a whole will have to have 207 units in service as of the first of 1954, accumulating to a total horse power of 8,280. These will be gas engine driven compressor engines.

We have spoken of compressor engines in the field by using the term "Booster Stations" in order that we may have a differentiation between the power that we have to install in the field and the power that is installed at the Fritch station, which we ordinarily call a compressor station in our words. It is the same thing, but geographically located at different points. We use the two terms for convenience in conversation.

Questions by the Examiner.

As to what will be the lowest possible intake pressure for these booster stations, I will say that these engines will operate to a very low intake pressure; but the lower the intake pressure the less the capacity of the engine to handle the compressed gas. If we were operating under one intake and the intake pressure diminishes, one way we could make an adjustment to operate would be by changing the gas compressor cylinder size. Those cylinders are removable.

Direct Examination Resumed by Mr. Morgan.

Pages 14 and 15 of this exhibit give details relating to the location of the various booster stations and to the number of engines in use at each station at the beginning of each year. There is nothing about that detail and correlating it with page 13 that needs explanation.

(At this point counsel for defendants offered EXHIBIT 100 in evidence, and it was received in evidence over the objection of counsel for each of the Commissions, to whom an exception was allowed. Motion by Commission Counsel to strike witness' testimony in connection with Exhibit 100 as deals with anything beyond a reasonably immediate future denied.)

I have prepared a map which shows the location of the 251 wells drilled and to be drilled after January 1, 1939,

and the location of the booster stations which are to be put into operation after the first of January, 1939.

(At this point counsel for defendants presented a map described as "Texoma Natural Gas Company, Panhandle Gas Fild of Texas, Gas Wells, Gathering System and Field Booster Stations." At the direction of the Examiner, the map was marked Exhibit 101 for identification.)

Exhibit 101 was prepared under my direction, and 646 shows the gas field property of Texoma Natural Gas Company. This property is divided by color between property existing in the field on January 1, 1939, and the property to be constructed thereafter. I will start with the top of the legend and go down.

The first symbol in the legend is a black circle opposite the words "Present wells," and that means that the several black circles show the location of the wells that Texoma had on January 1, 1939. Wherever that circle appears on this map, at that location Texoma had on production a well as of January 1, 1939.

The next symbol in the legend is a solid black line, and this solid black line shows the location of Texoma's gathering system in the Panhandle field as of January 1, 1939.

The next symbol in the legend is a solid green line, and this solid green line shows the location of Texoma's telephone system in the field as of January 1, 1939.

The next symbol is a black triangle, and this black triangle shows the location of the booster station which Texoma owned as of January 1, 1939. There was only one at that time, and it is located in Section 102, Block 5, I. & G. N. Survey, Carson County. That station is used for a series of wells as it is located there. As I recall the construction of the intake line to that station, it pumps out of the lateral line, and therefore all of these wells, including the one on the direct line, are feeding into that station.

The sold red line in the legend relates to the gathering system, that is, to the pipelines which Texoma will need to construct after the first of January, 1939, in order to connect with the wells which will come into production after that date and the general gathering system of the company.

The broken green line represents the telephone system construction which Texoma will have to make in the field after the first of January, 1939.

The solid red circle represents future wells to complete development, and the various points on the map on which these red dots are located give the location of future wells to be drilled by the Texoma Company.

I see that I have missed the red triangle, which relates to the location of booster stations to be installed by Texoma in the field after January 1st, 1939, and those are the 60 points that we spoke about in a previous exhibit, and they stretch throughout the field.

The remainder of the legend is a solid black line with diagonal red lines running through it, and a solid red line with diagonal red lines running through it; and these relate to the parts of the gathering system which we think Texoma will have to take because no longer usable. A diagonal red line across the black line indicates that
647 it is a piece of property existing on the first of the year 1939 and will probably become no longer usable and will be reclaimed. Where we find a solid red line with a diagonal red line across it, we mean to indicate that some construction after January 1, 1939, will later on prove to be no longer usable as originally built and will be reclaimed.

Exhibit 101 shows the geographic distribution of the wells already drilled, the gathering lines already in existence, and the booster stations in existence as of January 1, 1939, and the wells, gathering lines and booster stations as shown in Exhibit 100. All 350 wells are located on this map, and all the pipeline mileage and all the booster stations are shown here. Within the usual drafting limits, they are accurately located on that map.

(At this point counsel for defendants offered in evidence EXHIBIT 101, and it was received in evidence over the objection of counsel for each of the Commissions, to whom an exception was allowed.)

(Counsel for defendants offered in evidence EXHIBIT 91, and it was received in evidence over the objection of counsel for each of the Commissions, to whom an exception was allowed.)

Cross-Examination by Mr. Slaff.

I am requested to take any well or any year in the future and explain how I use Exhibit 89 to determine the open flow of a well to be drilled in one of the groups in any future year, showing the step by step method.

I am going to take the rock pressure decline map on Group 8 as an example of the determination of the rock pressure as of January 1, 1946. I wish to state that my actual calculations were based upon a calculation I have discussed in the testimony, but I shall use the chart for illustrative purposes.

On January 1, 1946, the rock pressure decline map of Group 8 shows that there was 292 pounds gauge well head pressure. If I might, I would like to forego the calculation on the weight of the column of gas and assume that 292 pounds was the formation pressure absolute as of that date. The symbol will be P_f. Having determined a formation absolute pressure of 292 pounds, I next go to the back pressure data chart for Well Group 8 in Exhibit 89.

In this chart relating to Group 8 the left hand scale relates to the pressure factor. The pressure factor is $P_f^2 - P_s^2$. In my illustration I will use 292 pounds as P_f and 13 pounds as P_s. The square of 292 is 85,264. The square of 13 is 169. The difference of the squares is 85,095.

We now find on the vertical scale the point 85 and proceed from that point to the right until it intersects with the composite back pressure line. We then proceed downward to the horizontal scale, and as I read the chart, we reach the horizontal scale at a value of 4,300,000 648 cubic feet per 24 hours, and, if I have not made a mathematical mistake or a chart mistake, I have given you the answer as to the method that we use in correlating rock pressure and the back pressure test data.

That is illustrative of the method. Actually we went through a formula because of the mass of information we had to prepare.

Questions by the Examiner.

To my mind, the significance of the words "back pressure" is twofold. It is to distinguish from the ordinary Pitot tube open flow method, where the gas leaves the well and blows to the air without there being anything to hold the pressure back against the sand, except the weight of the column of gas/ but in that particular test procedure illustrated on page 1 of Exhibit 89 we call that a back pressure test, or the Bureau of Mines did, because the gas is producing into the ordinary string of pipe,

the ordinary lateral line, and the pressure is being made in that line and being held back against the face of the sand rather than just blowing open to the air. The recorded data as to the well head pressures are the back pressures existing at the time the tests are recorded.

649 J. G. DICKINSON, a witness for defendants, recalled, testified as follows:

Direct Examination by Mr. Morgan.

(July 31, 1939.)

I have heretofore stated that my position with Texoma Natural Gas Company is that of general superintendent of production. My duties as general superintendent of production include supervision of the accounting department where charts from Texoma's meters are figured, gas royalty computations are made, and royalty checks are prepared. We have the job orders covering investment work done for Texoma, and a general set of Texoma's books is kept in the Amarillo office.

My duties also include supervision of the land and lease department. In this department we handle the taking of leases, the preparation of consolidation agreement contracts, and the handling of complaints and legal work.

I also supervise the geological department. In this department we keep maps, sub-surface data, sub-surface maps, analyses of well samples. The geologists recommends the location of wells and determine the depth at which casing is to be set. They locate the gas pays when the wells are drilled in. They keep statistical information and make reserve estimates.

The production department comes under my supervision. This department makes locations of wells in the field. They haul in rig material and casing. They furnish fuel for the drilling. They recommend the depth at which the first string of casing is set. They supervise the cementing of casing. They survey the hole to determine if it is straight. They watch samples and assist the geologist in the locating of the depth of the gas pay. They drill in and log gas pays. They inspect charts of well meters. They test wells and blow wells to remove water and cavings. They supervise the clean-out work.

In addition to these activities I act as agent for Texoma in Texas. I represent Texoma in dealing with the regulatory bodies and in matters of public relations. I am familiar, of course, with the contractual obligations of Texoma in the matter of its lease obligations.

I spoke of supervising the accounting that is done in Amarillo. That accounting, of course, is done under the general direction of Mr. Campbell, the secretary, who prescribes the system of accounting which I see is followed out in the keeping of accounts in Amarillo.

I am sure that Texoma has not a sufficient number of wells already drilled on its properties to meet its requirements for the future. We have plenty of open flow at this time to meet our requirements; but as the rock pressure declines the open flow of the wells will decline, and at a greater rate. The open flow will decline to a point
650 where we will not be able to produce enough gas from the presently existing wells to meet Texoma's outlets. In order to meet that situation we propose to drill enough wells to provide the requirements of Texoma's market; and, after giving thorough consideration to the problem, we have decided to do it in a uniform and orderly manner.

I have been requested to tell something about the history of the company's policy with reference to eastern Gray and Wheeler counties, and explain why Texoma would sell gas from those wells instead of connecting those wells into the pipeline system, in the light of the circumstance that Texoma will probably need more gas for its own purposes.

In the beginning Texoma had a considerable amount of acreage in eastern Gray and western Wheeler Counties, and we contemplated building a line into this area, not only to take care of Texoma's wells that we acquired in this area, but also to take care of any future drilling we might do. At about the time we were ready to start work on this line in Wheeler County, it was decided to postpone construction of it. We had sufficient gas on the west side to get us started, and we decided to defer building the line until a later date.

Early in the history of Texoma's production, the State of Texas became very lax in the administration of conservation laws, and stripping operations were finally permitted, which had a very serious effect on the pressures in the area of central Gray County and also in Wheeler County. This production of gas in these two areas brought

the pressures down to such an extent that we began to examine the problem rather critically to see whether we should build into the area at all. We finally decided that the building of a line into eastern Gray County and Wheeler County would not prolong the life of this project at all; that we would be able to get sufficient gas from the western area up to the time the field was exhausted; and exhaustion of the field was dependent not only on our own withdrawals but the withdrawals of others; so we finally determined that we would not build a line into eastern Gray and Wheeler Counties.

This resulted in our surrendering most of the acreage that we had in those areas in order to avoid the payment of rentals, taxes and other costs of carriage. With respect to building a line into the area to serve the wells which we had, we decided against this proposition because the cost of a line to take care of these wells would be more than twice the cost of drilling wells in other areas to provide the same amount of open flow that was available in these areas. The rock pressures in central Gray County and in Wheeler County are now at a point where we could not deliver gas into our pine line under present pressures.

Exhibit 101 does not extend far enough east to show the wells owned by Texoma in the Lefors area of eastern Gray County and the wells belonging to Texoma in Wheeler County.

Questions by the Examiner.

651 My attention has been directed to an isolated well with a proposed booster station, and a short distance from that, an isolated well and a proposed well, and I am requested to state what happens to those wells.

At such time as those wells decline to a point that they will not feed into the line against prevailing pressures, we will have to have booster stations. At the present time those wells are connected to Cities Service Company by an exchange agreement which is cancellable on 60 days' notice. The wells are so located that we can take them into our lines at any time we find it necessary. We have six wells that feed into Cities Service lines on exchange agreements.

Direct Examination by Mr. Morgan.

By that I mean that we are delivering our gas from wells which are near their lines and they are delivering us an equivalent quantity of gas from some wells of theirs which are near our lines. By that means we have been able to effect an economy by being able to avoid the building of gathering lines. Under these exchange agreements we simply deliver them a quantity of gas and they redeliver to us a similar quantity. No money changes hands; it is simply an exchange of gas.

The six wells connected to Cities Service are Purvis No. 1; C. C. Yowell; two J. J. Crutchfield wells, one of which is in Section 37, Block 4, I&GN Survey, Carson County, and I believe the other is in Section 38; Gulf No. 1-G, in Section 21, Block 5, which is several miles from our line; and Burnett D-1-G, in Section 34, Block 5, I&GN Survey, Carson County.

We also have some wells in eastern Carson County and western Gray County where we are now delivering to Phillips. We are doing that to avoid installing booster equipment right at this time. They are down in the low pressure area in western Gray County. Phillips is producing from wells in the same area into a line and can receive this gas at these low pressures where we could not do it at all. We would have had to build a booster station before this time in order to get that gas into our system against prevailing pressures. In return for that Phillips is delivering gas to us close to Fritch and they are delivering some of it from northern Moore County into our gathering lines.

By means of that exchange we have been able to keep our capital investment down, but up to this time I do not believe the amounts would be material. We would probably have had to build one or two small units in order to get this gas into our system. All of the wells east of a point in Section 25, Block 4, I&GN Survey, Carson County, are now delivering gas to Phillips. That is a temporary arrangement and does not result in decreasing the quantity of gas that goes into our system that would otherwise come from those wells by any quantity at all.

Except the Coltexo and Lone Star wells, which are not shown on this map, this covers all of the wells under exchange agreements.

652 The Phillips exchange is on a quality basis, and not on a well basis. It involves 18 million cubic feet daily.

On Exhibit 17 the wells in the Lefors area which are connected to Coltexo's pipeline are those wells located generally directly north of the non-productive area that is shown in white on Exhibit 17. There are now six wells connected to Coltexo, and the total open flow of these wells is approximately 15 million cubic feet. The rock pressures range from 146 pounds to 200 pounds.

These wells could not be economically produced into our pipe line system. We would have to build a compressor station and build a line over to the terminus of our line in Western Gray County. The terminus of our line is about five miles directly south of the town of Pampa, and it is about 15 miles from that terminus over to these Lefors wells. We would have to build a compressor station to pump the gas and build a gathering line to the wells. We would not be able to produce the gas into our line in the absence of a compressor station. It would not require an enlargement of any part of the additional line to take delivery into the system.

There are seven Texoma wells in Wheeler County connected to the Lone Star. I will name those wells and give their locations.

Gordon No. 1-T and No. 2-T are located in Section 91, Block 17. The rock pressure of both of those wells is 216 pounds. The open flow of No. 1 is 26,000,000, and the open flow of No. 2 is 21,000,000.

Hicks No. 1 is located in Section 53, Block 17, H&GN Survey, Wheeler County. It is in the center of the northeast quarter of the southwest quarter. Its rock pressure is 281 pounds, and its open flow is seven million.

Morgan No. 1 and No. 2 are located in Section 93, Block 17, H&GN Survey, Wheeler County. Morgan No. 1 has a rock pressure of 231 pounds and an open flow of 11,600,000. No. 2 has a rock pressure of 219 pounds and an open flow of four million.

Sewell No. 1 and No. 2 are located in Section 1, Block 24, H&GN Survey, Wheeler County. No. 1 has a rock pressure of 209 pounds and an open flow of 18,400,000. No. 2 has a rock pressure of 207 pounds and an open flow of 10,000,000. The total open flow of these seven wells in Wheeler County is 98,893,000. The average open flow of the wells is 14,000,000 per well.

Comparing the costs of building a gathering line over to Lefors and Wheeler County wells and drilling wells in the Carson-Gray area in the vicinity of our pipeline, as con-

templated in the program as portrayed on Exhibit 101, it would be more economical to drill wells in the western
653 part of the field. In fact, it would cost about half as much, or less than half as much, as building, for example, a ten-inch line into Wheeler County. The distance from the terminus of our pipe line over to those Wheeler County wells is about 29 or 30 miles.

Those wells in Wheeler County would not by means of their own pressure deliver gas into our Fritch station, and in order to get the gas from that Wheeler area we would have the same situation as that in the Lefors area, namely, that of building field compressor booster station equipment in order to deliver it in.

When I said that it would cost more than twice as much to build a pipeline and make the other investments necessary to deliver gas from these wells into our system, I was talking about drilling the same number of wells over in the Carson area.

The six wells in the Lefors area have a total of about 15 million cubic feet of gas daily. The situation in Lefors is such that all the wells over there have an open flow equal to about one well in the other part of the field, and what I said would apply to all of the wells in both the Lefors area and Wheeler County with respect to open flow; that is, we could drill the same open flow in the west part of the field at less than half the cost of building a line to connect this open flow in central Gray County and Wheeler County, because in one well we would get as much production as we have in all six of those in Lefors. Those are the six wells Mr. Kesinger testified were due to be plugged and abandoned in the next two or three years, and I think that is what will happen to them. They are in the same vicinity and in the same situation as the six wells we have already abandoned.

I said a while ago that it would not add any time at all to the life of this project had we connected these wells or had we developed the Wheeler and eastern Gray County leases and connected them into our pipeline system. By that I meant that the life of the Panhandle field and the life of Texoma's operations is going to be determined by the rate of withdrawals from all sources. Thus, we are able to get the gas we need in the western part of the field and the building of a line into the eastern part of the field won't be any help in prolonging the life of Texoma's pipeline, because the western part of the field is going to last

longer than the eastern part. The pressures in Wheeler County are quite low as compared to those in the western part of the field. This is reflected very graphically by Exhibit 17.

I understand about the limitations which Mr. Bussard referred to when he said he computed the future available open flow to Texoma on a basis of taking a maximum of 25% of the open flow daily from each of its wells. That is a legal requirement in Texas, that wells will not be produced in excess of 25% of their open flow.

It would not be safe for Texoma to so handle its drilling program as that it had barely four times as much as the daily outlet available from its wells, for this reason:
654 Texoma is required to shut some of its wells out in order to prepare them for rock pressure tests. Some of the wells are out of the line for clean-out operations. Some of the wells are shut out for blowing. The gathering lines freeze up in winter time, which causes the shut-out of some of the wells. In considering the number of wells and 25% of their open flow, Mr. Bussard has taken a theoretical viewpoint of it. It does not consider the practical angle. He is talking about the maximum that could be accomplished if conditions were at all times ideal.

Something has been said about some of the wells being off the line for blowing, and I am requested to state why it is necessary to have some of these wells off the line for that purpose and to describe that operation of blowing these wells.

Mr. Gailoup, our production field superintendent, inspects charts on Texoma's wells, and when he detects characteristics in the charts which he can identify, he goes out, or sends some of his men out, to blow these wells. This blowing is to take the water out of the well or to blow out cavings, and the process is to shut off the side gate where the well feeds into the gathering line and then open up the top gate and let the well vent itself to the atmospheric pressure. That blows the water or other foreign matter that has gotten into the well out through the top of the well.

Questions by the Examiner.

The charts referred to are recording charts. They record pressure and differential. The pressure pin makes a mark around the 24 hour chart and then the differential that measures the difference in pressure across the orifice also

records another line around the chart. These are meter charts.

Differential is the difference in pressures. On the upstream side of the orifice the pressure will be higher than on the downstream side of the orifice, and knowing the size of the hole and the difference in the pressures we calculate the volume of gas passing.

Direct Examination by Mr. Morgan.

I have spoken of water as one of the things which we blow out, which Mr. Galloup went into at some length, and I am now requested to explain how this other matter gets into the well or formation and why it is necessary to blow it out of there.

The gas as it comes into the hole is saturated with water and the release of this pressure tends to let some of this water drop out. This water runs down the sides of the well bore and causes the lime to flake up and causes the shale to cave. It becomes mud and falls into the bottom of the hole. This foreign matter accumulates and begins to have some effect on the producing characteristic of the well. It restricts the flow, or in some cases it causes the differential pin to be very erratic and to have a choppy motion when it should be smooth. We have to blow the wells to get this out in time, because if we leave it there too
655 long we have a clean-out job, and it has been my observation that some of this debris that is blown out may come from the producing horizon itself rather than off the walls of the well bore. Some of this water may begin to drop out back where this pressure begins to decline away from the well bore. For example, we have one well in Carson County that last week we had to blow twice because of the debris in the well, and it took about an hour each time to clear it out. The debris seemed to continue to come after an ordinary period of blowing, which usually does not exceed thirty minutes.

The operation of blowing the well will not be as effective as a means of cleaning out the water and debris from the bottom of the hole in the future as it is at the present time. As the pressure declines and the open flow declines, we reach a point where it will be very difficult to get this water and foreign matter out. We will then have to install tubing.

Mr. Bussard has testified that the schedule of wells to be drilled by Texoma in the future totals 215 wells, including those that have been drilled since the first of January, 1939. I assisted him in working out that schedule. My judgment is that that estimate is all right from a theoretical standpoint, but it does not take into account the practical considerations. It is based on the assumption that the theoretical flow characteristics of Texoma's wells are going to remain the same over their entire life, and that in turn infers that there will be no change in the reservoir conditions.

We are pretty certain that that is not going to happen. I had Mr. Kuhne make back pressure tests of 30 of Texoma's wells that were tested in 1932 and 1933 again in 1938 and 1939. We find that on those thirty wells the open flow which we would expect at a 100 pound pressure has declined 50% between the tests in 1932 and 1933 and the tests in 1938 and 1939. So we have rather definite evidence that there are going to be changes in that reservoir and also in the flow characteristics of the wells. I think from a theoretical angle Mr. Bussard's study is good; but, in my opinion, it is too conservative with respect to the matter of drilling.

(Motion by Commission Counsel to strike above testimony and objection to any future testimony dealing with a period beyond the reasonably immediate future denied and overruled. Statement by Company Counsel that the company is entitled to all future additions as part of present rate base.)

I have stated that there would be changes in the open flow of these wells indicated by these back pressure curves. The character of the changes will be such that it will tend to lower the open flow for the reason that the open flow is affected adversely by the mechanical clogging of the pore spaces, by the intrusion of water, and by changes of that character in the producing horizon. Those are the two fundamentals.

In concurring with the schedule of 215 wells to be drilled on Texoma's property as indicated by Mr. Bussard, I am concurring only to the extent that it is the indicated number if the potential could be expected to stand up to the indicated level which he has developed through his back pressure curves and pressure decline curves. I mean by that that I think more wells will be required than indicated by Mr. Bussard's study.

656 *Questions by the Examiner.*

In my statement that my observations between 1932 and 1938 showed a 50% loss from what we expected, I meant that the back pressure curves taken first indicated certain open flows at 100 pounds pressure and the second tests gave a result which was 50% less than the result we obtained the first time at 100 pounds pressure, indicating to me that the reservoir had plugged up to such an extent that it brought about this change in the result. It could not have been drained. In the event of drainage the pressure factor would have been taken care of in the curve. A change in the reservoir condition is the only thing that could explain it.

Direct Examination by Mr. Morgan.

What I am saying is that there were two back pressure estimates made, one back in 1932 and 1933 and another in this year and the latter portion of last year, and the open flow indicated on the second test was 50% lower than on the first test.

Cross-Examination Interposed by Mr. Slaff.

If the indicated open flow was ten million in 1932, 50% of that indicated open flow in 1938 would be five million. If the open flow were five million in 1938, 50% more would be seven and one-half million in 1932 instead of ten million.

Direct Examination by Mr. Morgan.

In order that the matter may be clarified, I will explain that the first back pressure tests were taken in 1932 and 1933, and the second tests were taken in 1938 and 1939. The results of the tests indicated that the open flow which would be expected at 100 pounds pressure was 50% less in 1938 and 1939 than was indicated in 1932 and 1933. That indicates to me that there is a change in the reservoir conditions to the extent that the pore spaces are obstructed so as to prevent the flow of gas into the hole in the manner which was indicated by the first tests.

Questions by the Examiner.

What I meant in my reply to Mr. Slaff's inquiry was that if the first figures were ten, then 50% less than that would be five. If the figures were five, 50% more would be seven and one-half. If I had an open flow of ten in 1932, I looked at the chart and figured that we would have seven and one-half million in 1938, and we actually came out at half of seven and one-half million. We read our back pressure curves to find our prediction for 1938, and the result in 1938 was half of our prediction. The rock pressure both times was above 100. We were reading on the chart at the 100 pound rock pressure mark trying to determine the open flows at 100 pounds by our back pressure chart method, and the result of the readings in 1938 and 1939 were 50% less than they were in 1932 and 1933. We constructed two back pressure charts on different dates 657 and got two different theoretical results.

Direct Examination by Mr. Morgan.

This was due to changes in that five year period between the times they were taken. That was not in all of Texoma's wells but just in 30 wells that we had data on in 1932 and 1933, and it indicates that in those 30 wells these mechanical difficulties we have been talking about here had intervened to thwart what would have been the open flow without further obstruction. We know that the open flows of Texoma's wells decline more in a period of time than is indicated by back pressure tests taken immediately after well drilling. We have that practical check on it.

We have drilled 18 wells so far this year, and will drill a total of 22 wells during this year.

The changes in the reservoir conditions due to water and shale are the things that change open flows as indicated by the back pressure curves. Those are the two fundamental conditions and are interchangeable.

My impression is that if the number of wells around Texoma's wells be increased and thus reduce the drainage area, it would not have any material effect on the flow characteristics of the wells except to reduce the pressure in the area more rapidly than that indicated.

Although we have a potential in our present wells ade-

quate to meet our present market requirements, we have already drilled some wells and will drill four more this year. We have made a considerable study to determine our drilling program, and for a number of reasons we have decided to adopt a uniform and orderly program. Some of these wells that we are drilling now are required by consolidation agreements. Some wells which Texoma is now producing are assigned large acreage assignments and are producing at a higher percentage of open flow than we think is desirable.

The drilling of wells now gives us an opportunity to anticipate and meet implied lease obligations with respect to the development of large leases. These implied obligations accumulate, and if we don't take care of them as we go along we get some complaints from the lessors. We can handle a uniform and orderly drilling program with a minimum investment in rigs and derricks and casing, and at less contract hauling expense.

We can handle a uniform and orderly drilling program with our present trained personnel. Mr. Galloup and Mr. Peterson have both had many years of experience in different fields, and we think it is desirable to handle a drilling program which our own men can take care of.

658 The producing of wells at a moderate rate of open flow, at a moderate percentage of their open flow capacity, results in less mechanical clogging of the pore spaces. There is less danger of water encroachment at moderate rates of flow. There is less formation of condensate in the well bore at moderate rates of flow. We obtain a better spacing pattern of our wells, and hence a more uniform drop in pressure as far as Texoma's operations are concerned, and this in turn will delay to some extent the installation of particular booster units. I believe that covers the reasons why we want to drill in a uniform manner.

That is the settled policy of the company and has been the settled policy of the company during a period of years. We have anticipated the drilling of wells in a uniform manner. To some extent in the early formation of our consolidation agreements we delayed drilling in order to bring leases into consolidation. For example, we are prorating on the basis of open flow and acreage, and we attempted to show the land owner that it was to his advantage from a royalty standpoint to put as many acres under the wells as he could. That situation helped us in the for-

mation of those consolidation agreements, and during that period we held up on some of our drilling in order to offer them the first well as an inducement to make these agreements.

I have seen the schedule of wells as outlined by Mr. Bussard, showing the nmber of wells to be drilled in each of the years from 1939 to 1951 inclusive, and I have taken that schedule of wells and developed the cost of drilling those wells. The costs of drilling these 215 wells drilled and to be drilled after January 1, 1939, were based on actual experience in drilling in the areas which we contemplated developing. A well in Moore County we estimate would cost $22,014, whereas a well in Carson and Gray Counties we estimate will cost $17,702.

Those two amounts take into account the difference in depth to which the wells have to be drilled and the difference in the formation characteristics, which will have the effect of making drilling in Moore County more difficult than it is in Carson County and also more costly. On the average, the wells in Monroe County would be 500 feet deeper than those in Carson and Gray.

Costs as of June 1, 1939, were used as the basis of our calculations in fixing the cost of those wells. It was necessary for us to figure out the number of wells that would be drilled in Moore County each year and the number of wells that would be drilled in Carson and Gray Counties each year. We have done that and have prepared an exhibit which sets up the schedule of costs of drilling these additional 215 wells.

(At this point counsel for defendants presented a document entitled "Texoma Natural Gas Company. Additional Capital Expenditures and Operation and Maintenance, Production Department. Witness, J. G. Dickinson." At the direction of the Examiner, the document was marked Exhibit 102 for identification.)

Page 1 of this exhibit is a summary of the additional capital expenditures of the production department of Texoma Natural Gas Company.

659 On the lefthand side of the sheet is a tabulation of the captions under which these capital expenditures will be made, and the years under which these expenditures come are shown at the top of the sheet and across to the right. For example, well drilling in 1939 requires an expenditure of $418,720. This amount in 1940 becomes $414,408, and so on.

Sheet No. 1 is supported by detailed sheets. Page No. 2 illustrates the information as to the number of wells in Carson and Gray and Moore Counties, and the cost in each county group, which supports the figure of $418,720 on the first line. Then the amount in each year is shown on page 2. The totals correspond with the amounts in the first line on page 1.

Turning to page 2, it will be noted that in 1939 we have five wells in Carson and Gray and fifteen wells in Moore. Further over on the same line we have $88,510 as the cost of the wells in Carson and Gray and $330,210 as the cost of the wells in Moore. The $88,510 is obtained by multiplying $17,702, which is the cost of one well, by five, the number of wells to be drilled in Carson and Gray Counties. In like manner the $330,210, which represents the cost of drilling in Moore County, is arrived at by multiplying $22,014, the cost of a single well, by fifteen, which is the number of wells to be drilled in that county during 1939.

That accounts for twenty of the 22 wells which I stated were scheduled to be drilled this year. The other two wells were commenced in 1938 but were completed in 1939, and were charged as of the time they were commenced.

The same explanation applies on down that column of figures on the upper half of page 2, making a total of 67 wells yet to be drilled in Carson and Gray Counties and 146 wells yet to be drilled in Moore County, at a total cost of $4,400,078.

That capital cost includes the drilling of the well and the casing, the master gate and the Christmas tree. The Christmas tree is represented by the fittings at the top of the well and includes the gate valves for the control of the well, which is a series of valves above ground. It includes the master gate and a gate on top of that for blowing and a side gate off the well and small valves to release pressures so that the big valve may be operated. These sums do not include the cost of installing a meter, the base on which that meter is installed, the meter connection, or things of that kind.

Going back to page 1 of the exhibit, a second line is shown called "Well Liners," and an aggregate sum of $18,450 to be expended during the years 1940 to 1947 inclusive. We usually finish our wells in eight-inch casing. As a well is drilled in we frequently encounter shale interspersed in the lime formation. This shale when the water condensate gets on it falls into the hole, and we have found

that by the installation of liners we can prevent some of this difficulty. These liners consist of six-inch pipe and are usually about 600 feet long. They extend from the bottom or near the bottom of the hole up into the eight-660 inch casing. These liners are slotted in each joint by an acetylene torch and long slots are cut in every joint of pipe so that we let the gas in but keep the formation back to a very large degree.

The thought might occur that the cavings would come in and shut off the slots. This was true when we bored holes instead of slots. The caving would get in there and plug that hole and seal it off, but usually in a slot there will be a little place where gas can get through and that gas would keep running that piece of caving up and down until it finally wore it out and blew it out. They are rather effective in keeping the well hole clean. That is similar to what is known as a sand point in a water well.

These liners we anticipate installing in 41 wells. These are wells that have already been drilled by Texoma but which do not have liners at the present time. We have liners in about 40 wells. There are some wells that we need to run liners in, but in some of them which we have drilled we encountered our open flow in too much volume to be able to run a liner. It is necessary to wait until that open flow declines in order to be able to get a liner down the hole.

In some wells the well appeared to be in such a condition after drilling in that we wouldn't need a liner, but we found later that we have a lot of trouble with cavings in these wells so that we will need to install liners. These liners will necessarily be installed at such time as we move in tools to clean out, because we will need the drilling machinery and the equipment in order to put the liner in the hole, and as we reach these wells for cleaning out in which no liners have been installed, it is our purpose and determination to install liners in those wells which we think need it.

It costs $450 to provide and install a liner in a well. We have $3600 for liners in 1940, which is a total of eight liners. We have seven in 1941, seven in 1942 and 1943 and 1944, two in 1945, two in 1946, and one in 1947, making a total of 41. I think that is the rate at which liners will be installed in these 41 wells. It is a program that I have developed in connection with my consultation with Mr. Galloup. It is quite likely that some of these liners will have

to be installed at an earlier date than scheduled here. These are the latest dates to which we felt we could delay this work.

The details as to installing these liners are shown on page 2. That shows the number in Carson and the number in Moore and the total number for each of the years from 1940 to 1947 inclusive, and the total cost. In my judgment, that sum of money will be expended in the installation of liners in Texoma's wells not later than the times indicated in this part of the exhibit, the second half of page 2.

Cross-Examination Interposed by Mr. Slaff.

I mean that in my judgment that sum of money will be expended and that the number of liners will be installed.

In making this estimate we based our prices on prices 661 as of June 1, 1939. In my judgment, that could well be a reasonable figure in 1947; but I have not formulated any judgment as to what prices will be or could be in 1947.

Direct Examination by Mr. Morgan.

On page 1 there is a third line, labeled "Well Tubing," in which we show a schedule of $11,585 for the year 1941, $17,313 for 1942, and varying amounts on through the year 1953. Texoma's wells are completed usually with eight-inch casing. As the rock pressure declines and as the open flow declines it will be more and more difficult to blow the water and cavings out of the hole. To alleviate this condition the common practice in gas well operation is to install tubing, which is usually two inches in diameter. This tubing extends from the top of the hole to about the center of the gas pay, and the installation of the tubing increases the velocity of the gas and permits the blowing of the water and debris from the hole at low pressures and with less gas loss than if it were blown out of the big hole, and it has the additional ability to get the water and cavings out in a great many cases where you could not do it without the tubing.

We have estimated that approximately 58% of Texoma's wells will require tubing. We hope that some of the areas will not become affected with water and that in some wells we will be able with our liners to keep down the debris to the extent that we may not have to have tubing in them.

It is possible that we have been too conservative in this estimate. We may have to have tubing in more wells. This represents our judgment as to the minimum amount of tubing which Texoma will be required to install. This tubing estimate is carried on the upper half of page 3 of this exhibit, and like the cost of drilling, the cost of installing tubing is controlled by the location for its installation. For example, in Carson County the installation of tubing cost is $1,094 per well, whereas a tubing installation in Moore County would cost $1,223.

That tubing stays in the well once it is installed. It is left in there and the well continues to produce from the casing, but when we want to blow the well we shut the valve on the casing and open the valve on the tubing, and it blows through the tubing. It is just a small metal pipe. It looks just the same as two-inch line pipe.

I have set out the number of wells which in my judgment will be tubed and the time they will be tubed in the Carson-Gray area and in the Moore area, separately, on the upper portion of page 3. It shows a total of 90 wells in Carson and Gray Counties and 114 wells in Moore County, a total of 204 wells out of the 350 wells that we estimate Texoma will eventually acquire. This makes a total of $237,882 that we will be required to expend for tubing.

The totals shown on page 1 under the first solid black line across the page and opposite the words "Total Gas Wells Expenditure" are simply the sums of the amounts to be spent for well drilling, well liners, and well tubing for each of the years 1939 to 1953, inclusive.

662 The next line is designated "Drilling and Cleanout Tools." There are three items, one of $25,780 for 1940, one of $28,270 for 1945, and one of $22,770 in 1951. I will explain the use to which we put cleanout tools and the necessity for having those tools from the standpoint of Texoma's production department.

As I have described previously, we are troubled to a considerable degree with the caving formation in the well bore. Sometimes this caving can be removed by blowing the wells, but oftentimes it forms that solid bridge and cannot be removed, or else it accumulates to such a degree in the bottom of the hole that it cuts off some of the gas pay.

We now have one cleanout machine which we expect to remodel. This is an old-style machine and in its present condition is hard to move around. We expect to utilize it and make it more portable. We anticipate the rebuilding

of one of our rigs at a cost of $3,100. The rebuilding of that machine we anticipate to cost $2,000. In addition to that, we intend in 1940 to purchase a new cleanout machine, which will cost $5,500. We will purchase two strings of tools at a cost of $7,590 each, a total of $15,180, making a total for the year of $25,780.

It will be necessary to buy a new cleanout machine and these additional strings of tools, even though we are going to overhaul the one we have now, because we expect to use one machine in Moore County and one in Carson County. There is quite a long distance between these two counties, and the moving of one machine from one locality to the other would cost a good deal of money, and we anticipate that one machine won't take care of our needs during this period. When these wells get in a situation where they must be cleaned out, it is necessary to clean them out before they are restored to normal production.

It is my judgment that this is a minimum requirement for cleanout and drilling machinery and equipment that Texoma will have to provide not later than the year 1940. In figuring the cost of that equipment we have used the cost as of June 1, 1939.

We anticipate that this equipment will take care of our needs until 1945, when it will be necessary to buy an additional machine. We calculate that by this time we will have worn out or lost the two strings of tools which we bought in 1940, and that we will be required to purchase a string of tools for the new machine and two strings of tools to replace the old tools, at a total cost of $28,270.

We estimate then that in 1951 we will have worn out or lost the three strings of tools we had in 1945, and it will be necessary to replace them at a cost of $22,770, making a total of $76,820. These costs were figured on the same basis.

When I speak of tools being worn out or lost, I refer to losing them in the hole and not being able to fish them out. It happens quite often if a line breaks, a drilling line breaks, and you are not able to get hold of it with fishing equipment or in fishing you mash out the end of the tools so you can't get over them, you usually wind up by
663 leaving them in the hole. Oftentimes, in a case like that we drill by them. We start a new hole and drill alongside them, but we still leave the tools in the hole. We can bring the well back on production but we cannot recover the tools under those circumstances.

If we do not lose the tools by 1945 it will not be necessary to make this replacement, except that we will wear out the drilling lines. We will have worn out the drilling line and the sand line and some of the surface equipment that goes with a string of tools. A large part of the string of tools will have to be replaced by that time whether we lose them or not.

This losing of tools in a well is a frequent occurrence. We have it occur in our drilling operations right along. Our contractors have that kind of trouble. We have lost tools in the well and been unable to recover them in two instances.

This detail of clean-out tools is set out on the bottom of page 3.

The detail of the next item of expenditure, "Houses, Garages and Warehouses," is found on page 4. In general, it represents the housing and garage facilities which we need to install to take care of our personnel during the years. As we drill additional wells we will require additional well operators and additional car and truck facilities. Our field housing facilities are located at Dumas in Moore County and at Kingsmill in Carson County.

In the year 1940 we have scheduled houses in the amount of $10,103 in the Dumas camp. In Dumas we anticipate the erection of one 4-room and one 5-room house in 1940. At the present time there are two houses at this locality. Both of them are occupied by employees of the gathering system. The two production department operators should have houses during this year. One of them lives in Amarillo and is driving to the field every day, and one of them lives in a little shack in Dumas. We also expect to build a 5-room house at Kingsmill during 1940, and to provide garage facilities as indicated in the estimate here. The total expenditure for that year will be $17,521. The items for garages at Dumas and Kingsmill are to take care of the company's cars assigned to these operators and also to take care of their personal cars.

The properties of Texoma in Moore County are pretty widely scattered. They cover an area of about 30 miles across. It is not possible for our production men to get around to attend to their duties without having a car, and that is why the company maintains company cars and puts them at their disposal in connection with the discharge of their duties. Also, from the standpoint of the man working out in the field and his own personal convenience, it is

necessary for him to maintain a car out there because otherwise his wife could not get to town very often. It is about 50 or 60 miles to the town of Amarillo, which is the principal town in that area.

The additional houses in 1942 and 1943, and on later,
664 1947, 1948 and 1951, are necessary as we increase our operating personnel, and that is based on the personnel required to operate the property, taking into account the number of wells which we expect to drill. The present personnel cannot continue to look after the wells as they are increased in number from year to year, and this will require the putting on of additional men and the providing of additional housing facilities.

It is my judgment that for these houses and garages which are set forth on page 4 in detail, the amounts shown on that page and in the recap on page 1, in the line designated "Houses, Garages and Warehouses," will necessarily and actually be expended by Texoma not later than the dates indicated.

I do not in my studies bring in an estimate of the cost of maintaining and keeping up these houses because that has been handled by Mr. R. T. Powers, who is taking care of the maintenance and repair of all houses in the Texas Panhandle. It is a part of his duty to keep up all the houses, not only at the Fritch plant but the houses assigned to production and pipe line employees out over the field, and those figures are shown in the studies that Mr. Powers brought here when he was on the stand, including Exhibit 94.

A warehouse is a place where we store materials that we need out in the field from time to time. The purpose of a warehouse is to keep the material in condition and protect it against the weather and against loss or theft.

The garages are divided into two classifications, one for company trucks and cars, and the other for personal cars of employees who are entitled to cottage facilities. The need for the garages for the company trucks and cars is the same as the need for a warehouse. We need those garages to protect the equipment from exposure to weather and to protect it against loss through theft.

A reason for the company's policy in making available to some of its employees cottage facilities and facilities for protecting their personal cars is that we need employees at those locations. In having them near the scene of their work we save automobile expense and we save time. It is

a matter of importance that these men be available in the area as much of the time as possible in order to take care of any emergency that might happen and be able to handle better the job that they do.

Another reason for providing houses is the competitive situation. Other gas companies operating in the field and other oil companies make a practice of furnishing houses for their men. The carbon black companies do it, also the oil pipeline and the oil producing companies, and if we are to retain the quality of men which we need in our operations we have to meet those competitive conditions.

I think I can best explain to what extent other gas pipeline companies, oil companies, refineries and carbon black industries provide housing facilities for their men out
665 in the field and around their plants by some illustrations. For instance, the Phillips Petroleum Company has a complete town right north of the town of Borger which is called Phillips, and was previously known as Whittenburg. There are several hundred houses in this camp. They have also provided playgrounds and tennis courts and various other facilities which are for the purpose of making their employees satisfied to live in that location. They have provided schools, and have actually built and operate a high school, that is, a public school that advances a pupil on through high school grades in that vicinity.

It is a proper and necessary thing in my judgment that those things be provided in that particular territory because if an employee lives in town he has available a great many facilities that are not available in the field, and since it is unreasonable to do the driving that is necessary for employees working in the field who live in town, we have in some measure to provide some facilities of that character in the field. I think without doubt that the employees consider the availability of a house and garage is a part of the compensation they get for working for the company. We know when we go after them to hire them for a job that that is one of the questions they ask us—is there a house available. To my mind it is just a necessary part of our operation.

Questions by the Examiner:

We charge a nominal rent for the houses. This rent just about covers the repair and depreciation of the property.

For those who do not have houses we do not have a subsistence allowance. The men for whom we do not furnish houses are as a rule temporary employees and we pay them by the hour. When we get through with the particular job we have for them to do we let them go. They are usually local people who live in the nearby town, and in a great many cases they are farmers who work part of the time on the farm and part of the time for us.

Direct Examination by Mr. Morgan.

Such revenues as are received from the rental of these cottages are included in the general revenues which have been brought in here by Mr. Woodford, for instance.

All the items on page 1 have been covered except the item of leaseholds. The $2,800 scheduled for leaseholds during 1939 has already been expended. It was made to acquire leases to be added to consolidation agreements that are already in effect. It was money we had to expend in effecting the consolidation agreement.

We are not through with consolidations. We will have additional work of this kind, and in our operating budget for the land and lease department we include money under the item of "Miscellaneous" to carry on the work of consolidation.

A considerable part of the expense of securing consolidations is expense incurred in getting the consent of the royalty owners under Texoma's wells to allow additional acreage to be put under those wells for production. Some of the item may be expended for the acquisition of an additional small tract or two; but that is not included in the investment item.

666

It is necessary to spend money in order to get the parties to join in a consolidation agreement because the royalty owner under a well will not get any more royalty if additional acreage is added than he is getting now. The compensation is to get him to permit additional acreage to be assigned to his well, and the money for royalty to be paid out of the production of the well that is on his own land. In other words, so far as he is concerned, he is satisfied with the situation without any consolidation if the well has already been drilled. A consolidation agreement affects him a little adversely because as we add additional acreage we further distribute the royalty payments that

are made based on acreage and open flow, and he thinks when we approach him with a consolidation agreement that it is something desirable from our viewpoint, and since he does not care anything about it his attitude usually is that he will do it if there is some money in it for him.

The figures on page 6 of Exhibit 102 show the amounts for operation and maintenance of the Amarillo office and the Amarillo land and lease department.

The lefthand side shows the classification of the items of expense, and across the page at the top are shown the years that these items of expense were incurred or will be incurred. From 1932 to 1938, inclusive, are actual operating figures. The next column shows the average from 1936 to 1938. That is the period during which the pipe line has been loaded and that is the reason those years were selected. Additional years are shown from 1939 to 1954, inclusive, and the figures in those years are estimated figures based on past expenditures, consideration being given to the fact that some additional expense will be incurred as Texoma does additional drilling.

We will have increased expense for clerical salaries, for instance, because we will have more charts to calculate and more incidental expense to handle in connection with the operation and maintenance of additional wells. This, of course, occasions increased office supplies and stationery and printing, and as we add additional help to calculate the charts and handle this work we will require additional office space, which will run our rentals up.

This is not just an offhand guess or estimate. We have carefully worked this estimate out and taken into consideration the past expense and tried to construct as accurately as we could the conditions with which we would be confronted as we added additional wells.

This applies to the other items as well as to clerical salaries, office supplies and the items which I have mentioned specifically, except that we have eliminated the item of miscellaneous expense and tried to classify it and include it in the other items.

667 It is my judgment, after due consideration and careful study, that Texoma will incur these expenses for operation and maintenance in our operations over the period of time covered by this exhibit.

I have not broken the expense of the Amarillo office and land and lease department down into any detail. I have broken the production department estimate down in detail,

and that is found on page 6-A. The details of this are subsequent to this page. There is no page 5 in this exhibit. We misnumbered it and called it page 6 and the other page 6-A.

We have classified well operation and maintenance under two main headings, one, well operation, and the other, well maintenance. Under well operation we show labor, material, car and truck, damages, traveling expense, gas royalties, and miscellaneous. Under well maintenance we show labor, material and car and truck. The details for the item of labor are shown on page 7, in which we have shown a unit cost per well. By unit cost I mean the cost on which our estimate is based by actual experience. In 1939 we estimate some increase in that cost due to adding additional wells and due to additional expenditures because of the aging of the properties. The unit cost per well for labor for the years is shown in the first column to the right of the column showing the years, and this means an average for each year.

The $72.50 represents the current unit cost for labor in the operation of our wells. It will be different for the other years because the property is aging, and it has been our experience that as wells grow older they require more attention, and we have attempted to allow for that in this estimate.

Since 1932 there has been a change in the working hours and in the wage scale of those engaged in the operation of the wells, and, therefore, in order to arrive at this unit cost, we picked last year where we had the latest year reflecting present hours of labor and labor scales, and the average cost per well in 1938 for labor was $72.50; for material, $9; for truck and car, $15.50; and for traveling expense, $3.50.

The righthand column represents the number of wells in operation connected to our gathering system in 1938, and for each year after that we have the number of wells that will be in operation. The advance from $72.50 to $73.04 per well for operating labor in 1939 is due to an allowance for increased attention to Texoma's wells as they become older. The same is true in materials, car and truck, and traveling expense. We have added seven cents per well for increased material; twelve cents per well for car and truck expense; and about three cents for traveling expense. Those estimates are based on actual

experience. That is what happens as wells get older. We have to allow for increosed attention as the property ages.

The same thing is true of maintenance. These unit costs increase as the property becomes older, and it requires additional labor and materials and car and truck expense for maintenance. Last year the average net mainte-
668 nance cost for labor was $4.50 per well; for materials, $9 per well; for car and truck expense, $1 per well. In 1939 we have stepped up the cost three cents per well for labor, seven cents for materials, and one cent for trucks.

The figures shown on page 6-A for labor, materials, and car and truck reflect the amounts calculated on a per well basis that are shown on page 7, with the exception that under "Well Maintenance" the item of cleanout expense is shown under "Materials," and under "Car and Truck," and under "Labor" expense. This cleanout expense is also represented in detail on page 8. We estimate that we will clean out one well a year for every fifteen wells in operation. That is based on experience, and it virtually means that we will give Texoma wells one cleanout operation during their producing life. This cleanout cost is estimated at $1,260, and that divided by fifteen gives a unit cost of $84 for cleanout per well per year for 1939.

This cost in 1946 becomes $2,060 per well, principally on account of the fact that we contemplate by that time the use of acid in our cleanout operations. These unit costs reflect by the number of wells the total cleanout cost shown in the fourth column on page 8, and at the bottom half of the page these costs are divided in percentages in order to put them under the items of labor, materials, car and truck and contract labor. The contract labor item is shown as "Materials" on page 6-A. In working down the figures shown on page 6-A, it is necessary to use pages 7 and 8 in order to correlate them.

Page 9 is a detailed example of the effect of the computation of those quantities based on those unit costs, as, for example, under "Total Labor" in "Well Maintenance in 1939" will be shown the figure $1,827. On page 6-A, under "1939, Labor, Well Maintenance," is $1,827. Another illustration would be to take the car and truck expense. In 1939 the total car and truck expense will be $1,904, as shown on page 9. That is made up of $136 for the unit cost of car and truck expense, $1,468 car and

truck expense incident to cleanout, and $300 incident to reclaim, and a total of $1,904. That appears on page 6-A under "Car and Truck Expense" in 1939 as $1,904.

We did the same thing for "Materials." The material item is shown in the upper right hand part of page 9, and shows for 1939 a unit cost of materials of $1,224; cleanout, $567; reclaim, $260; cleanout contract labor, $8,720, and reclaim, $1,509, making a total expense under that item of $12,280. Turning back to page 6-A and looking under "Materials" under 1939, we get $12,280. It is merely a work sheet to show the application of those factors.

Based on my experience in the discharge of my duties as general superintendent of production for Texoma Natural Gas Company, and the experience I had prior to going with the Texoma Natural Gas Company, and upon my knowledge of the conditions obtaining down there in that field and the problems to be met in connection with the production of gas for Texoma Natural Gas Company, it is my judgment that these costs of operation and maintenance reflected by this exhibit and shown on the different pages hereof will be incurred over the period of time indi-
669 cated in the exhibit, if the operations continue that long.

In this exhibit these costs, particularly the operating and maintenance costs, are projected on through the year 1954, at which time Mr. Bussard has concluded from his studies the pressures in the field will have reached an average of 25 pounds at the well head; but in bringing in these figures showing these costs down to that time I do not mean to imply that I believe that Texoma's property can be produced down to that pressure level.

Based on our experience in the Panhandle field, I am certain that operations cannot be continued to a pressure level of 25 pounds, because we have already found it necessary to abandon a number of wells at a much higher pressure. I have also had experience in other fields in which wells were abandoned at a much higher level, and I have had the opportunity to observe the operation of others in the Panhandle field, and it is my judgment that Texoma will not be able to produce its property below a pressure of 100 pounds.

In making this statement I am conscious of the fact that some falling off of Texoma's production will come about above 100 pounds. In other words, I do not think we

shall operate at full capacity down to 100 pounds. We will have some restriction in the amount of gas available to the pipeline before we reach that point, and a tapering off will begin at an earlier period. There will be some wells that may be produced below the 100 pounds, but at a very much lower total quantity of gas than would be required for the pipeline. Therefore, it is my judgment that the 100 pounds is a point at which we can consider the operation of Texoma would be concluded.

In order to have a larger quantity of gas at pressures ranging from 100 pounds up to 125 or 150 pounds, we could drill additional wells if it were economical to drill them. We have made a study of that situation and we do not believe it is economical to drill wells in that bracket. We consider it economical to drill a well if we can get our money back with interest during its productive life, and when the pressure conditions and the open flow conditions in the field reach a stage where we cannot hope to produce enough gas from a particular well that we might drill at that time to pay for the well and pay for its operation and maintenance, that well will not be drilled.

These 215 wells that Mr. Bussard and I have agreed will be drilled represent the limit of the number of wells that I think will be economical from the standpoint of Texoma, in the light of conditions that obtain down there and which will obtain as this record shows.

(At this point counsel for defendants offered EXHIBIT 102 in evidence, and made the following statement:

This projection of these figures through the years 1952, 1953 and 1954, is due to the circumstance that we can rely only on the judgment of witnesses as to whether this project can extend beyond the year 1951. Mr. Bussard has brought in figures showing that the pressures 670 will have been pulled down to 25 pounds by the end of 1954. For the purposes of calculation we have put in what it will cost if it were possible to conduct these operations until the pressures reach such a level as that. However, Mr. Kesinger has testified, and now Mr. Dickinson has testified, that in their judgment these wells cannot be produced through the year 1954 but that production will stop prior to that time. Mr. Kesinger said two or three years prior, and Mr. Dickinson says to ground the average pressure at the well head of 100 pounds.

Now, we are entitled to have this record in such shape

that if the Examiner were not to agree with Mr. Dickinson we would have some basis for computing the operating costs and the replacement costs down to such time as the Examiner finds that Texoma will be able to produce these properties, and it is a simple matter, if it should be deemed that Mr. Dickinson is correct and that these properties cannot be economically produced when the pressures reach 100 pounds, merely to chop off any expenses of operation or maintenance, or any capital expenditures, and the revenues also, after the time when it is found that we shall have reached the end of the life of this project. Upon offer of Exhibit 102 in evidence by Company Counsel objection was made by Commission Counsel to the introduction of the exhibit and to the witness' testimony with respect to it on three grounds, namely, the witness had testified he had no judgment as to what prices would be in the future, the exhibit and his testimony deals with a period of time beyond any period which can be deemed to be the reasonably immediate future, and, according to the witness' testimony it is inconsistent with Exhibit No. 91. Company Counsel in reply to the objections stated that the reason for the projection of the figures through the years 1952 through 1954 is due to the circumstance that only the judgment of witnesses can be relied upon as to whether the project can extend beyond the year 1951.)

Questions by the Examiner.

If operations should cease, taking a hypothetical case, in the year 1950, my estimates up to that point would be unaffected. My opinion as to the year when it will be necessary to cease operating is reflected in the chart which I introduced the last time I testified, showing the total withdrawals from the field cumulative at the point they cross Mr. Peterson's estimate of recoverable reserves at 100 pounds, which is the point at which I think we will cease operations. That chart is Exhibit 87.

I got that for the early part of 1948, but as we approach that period we begin a tapering off. As I explained, we will abandon some wells, and during the later years we won't reach our full requirements, and some requirements will be obtained below 100 pounds; but the effective abandonment pressure I have set at 100 pounds.

Direct Examination by Mr. Morgan.

In other words, the withdrawal from the whole field would have been cut down prior to that time so as to defer the time when the pressures will have gone down to 100 pounds. As I recall the figures, that will be during the year 1951. I will check my figures and make a positive statement about that.

Questions by the Examiner.

The note on page 7 is to add $50 per year to operation materials, starting with 1944, for additional warehouse facilities. That is added into the total of the materials and is shown on page 6-A in addition to he other data that appears on page 7.

671 All of these reclaim items concerning labor represent simply the labor expense in reclaiming some material.

If economical operations cease in 1951, that would not in any way affect the operation and maintenance expense up to that year. The rate of acceleration of decline would have something to do with changing those figures but in making our estimates we have tried to take into account the fact that there will be some decline in production in those later periods. I think Mr. Bussard and I both agree that there will be a rate of decline there.

(At this point EXHIBIT 102 was received in evidence over the objection of counsel for each of the Commissions, to whom an exception was allowed. Motion to strike witness' testimony denied.)

Cross-Examination by Mr. Slaff.

Under the item "Gas Acreage Rentals" this expense in 1939 will amount to $7,835 in 1940, $992; and in 1941, $720. At the end of 1941 Texoma will have under production all the leases it intends to keep and no further rentals will be required. That is to say, all the wells will not be drilled by that time, but in my judgment all the acreage will be under production. That would be reflected in the item "Gas Royalties" on page 6-A from that point on. The royalties are based on the total amount of gas which Texoma produces and are determined by the quantity of gas which Texoma does produce.

I have testified by affidavit in those gas proration cases which have already been mentioned, the same that Mr. Peterson testified in. I testified before the Texas Railroad Commission at one time in 1931 concerning the Common Purchaser Act, which had just been passed when we started operations in Texas. The extent of that testimony had to do with whether or not I thought a gas producer without a market outlet should be given part of Texoma's market. I did not believe so. I think that was in October, 1931.

672 R. G. STRONG, a witness for defendants, testified as follows:

Direct Examination by Mr. Hedrick.

(July 31, 1939)

My name is R. G. Strong. I live in Evanston, Illinois. I am 46 years of age.

I was graduated from high school in the spring of 1912. In November, 1912, I enrolled in the Machinist Apprentice Shop School of the Westinghouse Air Brake Company, Pittsburgh, Pennsylvania. The factory for this company is located at Wilmerding, Pennsylvania, a suburb of Pittsburgh. In connection with the shop practice obtained in this course, the Westinghouse Company conducted regular classroom work. In this connection I studied the subjects of mechanical drawing, shop arithmetic, trigonometry, analytical geometry, calculus, Steinmetz' theory of alternating currents, and also during my course at that time I had work as an instructor in the Y. M. C. A. night school, instructing in mathematics. I continued this course until 1915, at which time I completed it.

Immediately upon such completion, I secured employment with the same company as an assistant foreman in the manufacture of three-inch shrapnel shells for the British government. At the time the Westinghouse Company received this order, they did not have a building nor equipment available for the production of these shells. I assisted with the installation of all automatic equipment and with the initial tooling and final production of this order.

This work continued until September, 1916. At that time I enrolled in the engineering school of the University of

Michigan. At the time of my matriculation I received credit from the university for the mathematics and shop practice that I had received at the Westinghouse Air Brake Company. I attended the University of Michigan for the term 1916 and 1917.

Early in the fall of 1917 I secured employment as a foreman of the machine shop of the Aetna Chemical Company, Carnegie, Pennsylvania.

In December of the same year I left this company and enlisted in the U. S. Navy as a machinist's mate. After my two weeks detention period at the League Island navy yard at Philadelphia, I was assigned to duty on board the U. S. S. Maine.

In July of 1918 I passed an examination for admittance to the Fifth Officers Reserve Class to be enrolled that fall at the U. S. Naval Academy, Annapolis, Maryland. In September, prior to my enrollment at the academy, I received my commission as an ensign in New York City. In October I entered the engineering class of the Fifth Officers Reserve Class and during a four months' period I had an intensive course in U. S. naval marine engineering.

673 In February, 1919, I was assigned to duty on the U. S. S. Mississippi. While on board that ship I was responsible for the engineering performance record. I was also assigned as an assistant officer in the maintenance of all auxiliary equipment. My regular watches were stood in the main engine room, which happened to be steam turbines.

I was discharged from the U. S. Navy in July, 1919. In September, 1919, I obtained employment with the Empire Gas & Fuel Company, Bartlesville, Oklahoma. I was located at their camp near Eldorado, Kansas. My work was that of mechanical drafting and general machine shop practice in the Empire Company's machine shop. In July, 1920, I was given the position of superintendent of this machine shop. This also included supervision of the central heating plant, auxiliary electric power generating plant and the ice plant, and, two or three years later, the boiler shop department.

I continued in this capacity until April, 1926, at which time I was transferred to the engineering department of the Empire Companies at Bartlesville, Oklahoma. My work in that department consisted largely of general engineering problems, the major one of which was oil and gas pipeline construction.

Under the immediate supervision of Mr. E. V. Kesinger, I handled the details of the preparation of specifications and contracts, the awarding of contracts, ordering and shipping materials, and the direction of all field inspection of pipeline construction, and during this time made trips to the field to check the progress of pipeline construction and also to check the understanding that the various inspectors had as to the application of the specifications in connection with the pipeline construction.

Late in 1928 the Texas Pipeline Company and the Empire Pipeline Company formed what is known as the Texas-Empire Pipeline Company. This project consisted of the construction of a 12 inch oil pipeline from Cushing, Oklahoma, to Chicago. I was assigned to duty on the construction of this pipeline as supervisor of all field inspection.

I continued on this project until its completion in the early fall of 1929. At that time I returned to the engineering department of the Empire Companies at Bartlesville, Oklahoma, and was assigned problems relating to the initial development of the Texas-Chicago pipeline project. That is what is known now as Texoma Natural Gas Company and Natural Gas Pipeline Company of America.

During this preliminary work, until June of 1930, I specifically took part in the development of the pipe that ultimately went into the construction of the Texas-Chicago pipeline. In connection with this experimental work I assisted with the development of the physical and chemical properties of the pipe, and also assisted with testing to determine the weldability of the steel.

In June, 1930, I joined the Continental Construction Corporation and was assigned the duty of preparing spe-
674 cifications, contracts, ordering materials, routing materials, supervising field inspection of the Texas-Chicago project. This work was all handled under the direct supervision of Mr. E. V. Kesinger, chief engineer, and Mr. S. E. Campbell, assistant chief engineer.

During the course of the construction of the Texas-Chicago pipeline I made frequent trips to the field to determine the actual physical conditions as they related to the construction of this pipeline. In July, 1931, I was given the position of superintendent of pipelines, which position I now hold.

My duties in this position consist of the operation and maintenance of the entire pipeline system, by which I mean the gathering system of Texoma Natural Gas Company,

the main line of Texoma Natural Gas Company, and the main line and its branch lines of Natural Gas Pipeline Company of America. In this connection I am responsible for the transportation of natural gas from the time it leaves the well head until it passes our respective sales meters.

In addition to my operation and maintenance activities, I also supervise all capital expenditures that are made in the pipeline department in the interest of both companies.

In addition to the mechanics of transporting gas from Texas to Chicago, a distance of approximately 900 miles, there are three factors which have constantly been a guide to me in supervising this maintenance program of the pipeline system. These factors are; safety of employees and of the public in general, protection of private and public property, and continuity of service.

The forces of nature, as well as other factors, are constantly working against this desired protection. Those forces are rain, floods, wind, drouth, landslides, earth tremors, lightning, snow, and ice. In the short life of this project we have experienced the effects of all of these forces in some degree.

On the average we have from 200 to 225 employees under my supervision. This number fluctuates considerably. We have had as few as 125 or 130 and as many as over 500 at a single time.

(At this point counsel for defendants presented a map entitled "Natural Gas Pipeline Company of America-Texoma Natural Gas Company: Map showing Location of Property, Pipeline Department." At the direction of the Examiner, the map was marked Exhibit 103 for identification.

Counsel for defendants also presented a map entitled "Natural Gas Pipeline Company of America, Map Showing Location of Property, Pipeline Department," and at the direction of the Examiner this map was marked Exhibit 104 for identification.)

I will first discuss Exhibit 103. The organization of
675 the pipeline department of Texoma Natural Gas Company and Natural Gas Pipeline Company of America has the entire line or entire system divided into three divisions. Each division is subdivided into two districts.

District No. 1 of Division No. 1 is known as the gathering system of Texoma, as shown on the large scale map, Exhibit 101.

The main line of Texoma is known as District No. 2, which begins at the Fritch compressor station and terminates at compressor station No. 2 near Gray, Oklahoma.

These districts are designated on the map by name.

District No. 3 is in the system of Natural Gas Pipeline Company and is that part of the pipeline which begins at compressor station No. 2 and terminates at compressor station No. 5.

District No. 4 begins at compressor station No. 5 and terminates at the Missouri River, south of Plattsmouth, Nebraska.

Exhibit 103 represents what we term the south half of the system.

Continuing on Exhibit 104, District No. 5 is divided into two subdivisions, 5-W and 5-E. 5-W represents the western half of Iowa, beginning at the Missouri River, proceeding east to a point south of Indianola, Iowa, and District 5-E is the eastern half of Iowa, beginning at a point south of Indianola, Iowa, proceeding in an easterly direction to the Mississippi River crossing south of Muscatine, Iowa.

District No. 6 is that part of the system in the State of Illinois, which also includes what we term the branch lines.

The Joliet meter and regulator stations are located at the eastern terminus of the 24 inch line, and they are also under my supervision.

Referring to Exhibits 103 and 104 and the designations on the left side of the exhibits from top to bottom, the top line shown in pink, entitled "Single Line Stream Crossings," refers to a number of stream crossings, to which reference will be made during the presentation of the pipeline exhibits.

These combination horizontal and vertical lines, and in some cases vertical lines, extending downward, show more specifically the location of these stream crossings with respect to the main 24 inch ling, which is shown throughout in red.

The purple legend is entitled "Compressor Stations" and it shows the location of the respective compressor stations from 1 to 10, inclusive. The location of each station with respect to the pipeline is also designated in the same manner as has been explained.

676 The next horizontal line in red reads "Gate Valves."

A gate valve is, in general design, the type of valve which we commonly know of or see in oil, water and air

service. In this connection it is a large piece of equipment specifically designed for this pipeline system; in fact, the valve was constructed in accordance with the specifications of the engineering department of this company.

These gate valves are nominally located every ten miles along the pipeline, with the exception of where a multiple line river crossing is encountered. At that place the multiple line river crossing gate valves are used in lieu of a main line gate setting.

Counsel has commented that between gate valve No. 7 and gate valve No. 11 the distance is something over two inches, while the distance between gate valve No. 6 and gate valve No. 7 is only a little over an inch, and has inquired if I mean that within the space between 7 and 11 there is a river header with a valve that we can utilize as a gate valve. At this location there is not a river crossing. Compressor station No. 2 serves as a block gate for that particular location. There is a main line valve in the pipeline at that point.

Continuing this example, there are two multiple line river crossings between main line gates No. 11 and No. 12, namely, Willow Creek and Beaver River. These crossings serve the same purpose as the main line valves as far as controlling the flow and stopping the flow is concerned in the pipeline system.

The main line gate valves are 24 inches in size. They are what we term a flange valve. They are steel constructed throughout. They were specially designed and constructed for this pipeline system. The inside working parts were all made of stainless steel. The valve alone is worth about $1200, and weighs two and one-half tons.

The numbers in the red circles designate the numbers of the gate valves as they are shown on the records of the company.

The next horizontal line in brown is entitled "Swage Drains." These drains are shown in a brown colored triangle over the entire system. The swage drain is a pipeline connection which is welded to the bottom of the 24 inch pipe to provide an outlet when coupled with a subsequent installation of a tank for the accumulation and removal of condensate.

The installation of the swage drains at the time this pipe line was being constructed followed the general procedure and practice of pipeline construction at that time. This company pioncered in the design and construction of a de-

hydration plant, the purpose of which was to remove the condensate from the gas before entering the pipeline system. At the time of the design of this line we had no idea what the efficiency of this dehydration plant would be. We have since learned through experience that the dehydration plant has been efficient and the subsequent use of the swage drains has not been needed.

677 We have started a program of removing and reclaiming these swage drains. All of them have now been removed from the main line of Texoma Natural Gas Company between compressor stations Nos. 1 and 2. That reclaiming or removing is designated by the word "Reclaim" or the abbreviation "Rec.," which will be noted under each swage. Additional swages have also been reclaimed from the pipeline system. The same notation of "Reclaim" has been made. The number in each one of those triangles is the number which has been assigned by the company to each one of those swage drains, and that number is as it appears on the records of the pipeline company.

Cross-Examination by Mr. Slaff Interposed.

After we retire them from plant and service we put the usable material in warehouse stock and junk the remainder. We have found the gate valve and the flanges to be usable; but I cannot say offhand what percentage that is of the material.

Direct Examination by Mr. Hedrick.

The next horizontal line, shown in orange, indicates the installation of drips under the entire pipeline system. The drips are also numbered and are so shown on the records of the pipeline company. The "Rec." under some of the drip numbers means "Reclaim" as I described it with reference to swage drains. A number of the drips have now been reclaimed due to the fact that they were no longer needed for the purpose for which they were installed, and also to the fact that they represent, as they were constructed, a hazard to pipeline operation.

The bottom horizontal green line, or last line, is entitled "Mulfiple Lines Stream Crossings." That shows the location of each multiple line stream crossing, that is, each stream where there are two or more pipelines installed. The three lines at the locations of the multiple line cross-

ings are only a legend used on this map to designate a multiple line crossing, and have nothing to do with the number of lines involved.

Exhibit 103 contains a red line which is fairly straight across the map but when we get over here to the east end of the exhibit the line, instead of being straight, swings down to the south for a couple of miles and then up again where it crosses the Missouri River. That is a location where rights of way could not be secured to project a straight line, which necessitated a deviation to the southeast. In other words, instead of continuing the line straight on across to the Missouri River, we brought the line around those places where we were unable to secure rights of way from landowners.

On Exhibit 104 the red line which designates the pipeline is not as straight generally as it was shown on Exhibit 103. The pipeline as it proceeds across the States of Iowa and Illinois deviates more or less from a straight line. There are two reasons for this, one of which was our inability to secure rights of way, and the second is due to certain physical conditions of topography which prevented the
678 construction of a straight line, such as the particular roughness of the country across Iowa and certain portions of Illinois. In other words, when we came to a bad hill or bluff or some other physical obstruction in the terrain, instead of building the line up over that obstruction we went around it, if it accomplished better pipeline construction.

We have a program for the removal of swage drains and alteration of river crossings, the details of which will be brought out as we proceed.

I have complete supervision of the gathering system of Texoma Natural Gas Company as shown on Exhibit 101, with the exception of the property at Fritch and the individual wells, which come under the production department. I have supervision over the 24 inch main gathering line and the lateral lines leading from the wells to the main trunk line. Exhibit 101 represents a true picture of the main trunk gathering lines and lateral lines of Texoma as they exist at the present time and are shown in black on Exhibit 101.

The swage drains which have been removed and will be removed in the future, and also some of the drips which have been removed, have been used by the company in the past.

(At this point counsel for defendants offered in evidence EXHIBITS 103 AND 104, and they were received in evidence without objection.

Counsel for defendants then presented a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Additional Capital Expenditures, Pipeline Department. Witness, R. G. Strong." At the direction of the Examiner, this document was marked Exhibit 105 for identification.)

Exhibit 105 represents amounts to be expended as additional capital expenditures by Natural Gas Pipeline Company and Texoma in the pipeline department, of which I have jurisdiction and supervision.

On page 1 of Exhibit 105, under the heading "Additional Capital Expenditures," where the word "Texoma" appears, those additional capital expenditures of Texoma Natural Gas Company, of which page 1 is practically a recapitulation, are shown in more detail on page 2 of the exhibit, and the line entitled "Natural Gas Pipeline Company" is explained in more detail on page 7 of the exhibit.

Under the heading "Book Cost of Equipment Retired" the retirements of Texoma Natural Gas Company and Natural Gas Pipeline Company are shown, and these are explained in more detail on pages 2 and 7 respectively of Exhibit 105.

The items shown under the heading "Salvage" are explained in more detail on pages 2 and 7 respectively of the exhibit.

The number of years in the first line represents the 679 years during which the expenditures shown will be made, and the additional capital expenditures to be made during those years are shown in recapitulation form directly below the designated year.

Turning to page 2 of Exhibit 105, line 1, entitled "Gathering System," line 2, entitled "District No. 2," line 3, entitled "Booster Stations," and line 4, entitled "Tools," are explained more in detail on pages 3, 5, 4 and 6, respectively, of Exhibit 105.

Under the heading "Retirements" the retirements of gathering system, District No. 2, booster stations, and tools are explained more in detail on pages 3, 5, 4 and 6, respectively, of the exhibit; and the same is true with respect to the sub-heading "Salvage."

The amounts to be expended for these different items

designated on page 2 are set out for each year during that period of time under the headings 1939 to 1954, inclusive.

The information as to the lateral lines to be constructed by Texoma Natural Gas Company from 1939 to 1951, inclusive, and also as to item No. 2, entitled "Meter Houses," was obtained from Mr. R. M. Bussard of the engineering department, under Mr. G. M. Davidson's supervision, as chief engineer and superintendent of operations. The information which I received from Mr. Bussard and Mr. Davidson is contained in Exhibit 100, which was introduced in evidence during the testimony of Mr. Bussard.

The lengths of line, the sizes of the line, and the location of the lateral lines to be constructed are shown in Exhibit 100. These future gathering lines shown on Exhibit 100 are shown in red lines in Exhibit 101.

After Mr. Bussard gave me that information, it was my responsibility to develop the costs of constructing each of the lateral lines as shown in Mr. Bussard's Exhibit 100; and throughout this entire Exhibit 105 I used prices for labor and material going into the additional capital expenditures by the two companies as of June 1, 1939.

After getting the information from Mr. Bussard I proceeded to calculate the cost of constructing each one of the lateral lines shown in detail in Exhibit 100 and depicted on Exhibit 101, and the figures set opposite line No. 1 on page 3 of Exhibit 105 for the years 1939 to 1951 represent the capital expenditures to be made for the construction of lateral lines shown by Mr. Bussard's Exhibits 100 and 101 in each of the respective years 1939 to 1951, inclusive.

Line 2 is entitled "Meter Houses." A meter house is a small corrugated, galvanized iron building, constructed on a steel framework. The size of this building is six feet wide, eight feet long, and seven feet high. The purpose of this building is to house the orifice meter gauge. One of these houses, which includes the meter setting, is constructed at each well immediately upon its completion.

680 The number of wells to be drilled by Texoma Natural Gas Company beginning with 1939 and terminating in 1951 was given to me by Mr. R. M. Bussard and is contained in a tabulation presented by him marked Exhibit 100. After I received the information as to the location of these wells, I assigned a meter house to each well. The cost of a meter house as represented by this exhibit is $139. I do not know the total figure as to how many will be built

in the years 1939 to 1951, inclusive; but it is in Mr. Bussard's exhibit. I have the figures by years.

In 1939 we will connect 22 wells; in 1940, 20 wells; in 1941, 20 wells; in 1942, 20 wells; in 1943, 20 wells; in 1944, 20 wells; in 1945, 18 wells; in 1946, 19 wells; in 1947, 18 wells; in 1948, 16 wells; in 1949, 12 wells; in 1950, 9 wells; and in 1951, 1 well.

It is quite necessary that meter houses be constructed over each meter for the protection of the meter itself and the equipment contained within the meter house from weather conditions.

Line No. 3 is entitled "Construct Bridge Across Big Blue Creek," and shows an expenditure in 1942 of $54,508. Big Blue Creek, which is referred to as item No. 3 on page 3 of Exhibit 105, is located on the Bennett ranch in Moore County, Texas. This creek is now crossed with a single 24 inch pipeline. During the past few years we have had considerable maintenance expense at this crossing for the purpose of protecting the 24 inch line and the continuous flow of gas through the line. These expenditures have been made for the protection of the banks from erosion and for the protection against erosion of the stream bed and the widening of the stream. We have used such facilities as concrete wing walls, concrete anchors around the pipe, split steel reinforcing sleeves around the couplings, and what is known as jetty protection.

This work has been only partially successful. The width of the channel at the present time is 356 feet, which indicates an increase of 60 feet since 1931, which is the approximate time the river crossing was first constructed. This stream normally carries a very small amount of water. In fact, it can be jumped across at times, or easily waded. Due to the topography of the drainage area, the drainage from rains is very rapid. In fact, this stream can change from a very small quantity of water to one of turbulent intensity, having a depth of 12 to 16 feet.

The bed of this stream is sand with a depth of approximately ten feet, resting on a shale sub-surface. During these flood periods the entire body of sand moves en masse downstream. The forces thereby developed against a structure such as a pipeline are obvious.

I desire to relate an experience that we have had with our gathering system crossing at another point on this same creek, which is on the Sneed ranch, and is located southeast of the Bennett ranch. This crossing was orig-

inally constructed with two 18 inch parallel submerged pipelines. In 1935 we experienced one of these floods which I mentioned. As a result of that flood the upstream 18
681 inch pipeline failed or broke in two at the south bank. We then started to reconstruct that crossing. Before the work was completed we had a second flood which completely reversed the arc of the pipe from an upstream arc to a downstream arc. We were then convinced that it would be futile to spend additional money at that crossing for a submerged crossing. As a result of that, we decided to construct a suspension type bridge. A picture of that bridge was introduced through the witness Floyd C. Brown and is marked Exhibit 78.

The present suspension bridge across Big Blue Creek in Moore County, Texas, is located on the Charles Ragsdale survey block on the Sneed ranch. It is approximately six miles north and west of the Moore County Canadian River crossing at the point I am indicating on Exhibit 101. The crossing of Big Blue Creek with the single 24 inch line, at which place a suspension type bridge is planned, is located on the W. E. Bennett ranch, which is in Section 3, Block M-1, Moore County, Texas.

Page 18 of Exhibit 105 represents the amount of river work that has been done by Texoma and Natural Gas Pipeline Company from the time the original line was constructed in 1930 and 1931 to January 1, 1939. The description of this work is shown by the respective pipeline district numbers. The year is given in which the work was performed, the county and state are also shown, and the actual costs of the work performed. Some of this work was maintenance work. It does not all represent capital expenditures.

Questions by the Examiner.

Prior to 1935 on the Big Blue River crossing we had two 18 inch lines, and it was then changed to a bridge. After constructing the bridge we then installed two 18 inch lines on the bridge. We originally had two 18 inch lines submerged across the creek or river. We still have two 18 inch lines across the stream on the bridge.

The Big Blue crossing on the Bennett ranch is becoming increasingly important. This is due to the fact that there will be additional production from those sections of Moore County to the west, northwest and southwest of the Big

Blue crossing. In order to safeguard the delivery of this gas and provide for continuity of service, we are going to construct a suspension type bridge across this stream in 1942, at an expenditure of $54,508. We will also construct on this bridge two 18 inch parallel lines.
(August 1, 1939)

Direct Examination by Mr. Hedrick.

Yesterday Mr. Slaff asked me a question concerning Exhibits 103 and 104. As I recall the question, it was what percentage of the material salvaged from the reclaim of a swage drain was usable, and I replied that I didn't know but that I would get the information. I was in error when I answered the question, due to the fact that I had in mind the usable material salvaged from the reclaim of a drip instead of a swage drain. There is no salvage from a 682 swage drain; it is all junked.

I wish to advise further with respect to the Big Blue Creek crossing. This is Big Blue Creek on the Bennett ranch in Moore County, Texas. Just before coming over this morning I had a report from the operating superintendent in Texas, who advised me that floods within the past two or three days have caused additional damage at that crossing to the extent of about $1000. This is further evidence of the forces of nature which are continually acting against the maintenance of a pipeline system. The results of these forces cause a considerable portion of our continued expense.

I did not get a complete report this morning of the nature of the damage, only that the river was wider than it had been known to be before; and I assume that more of the pipeline will have to be anchored and more of the couplings will have to be sleeved in order to stabilize the line at that point.

On line 4, page 3, of Exhibit 105 is a provision for an expenditure of $167,482 in 1940 to construct two 12 inch Canadian River lines. This Canadian River crossing is the Moore County lateral of the Texoma gathering system. On Exhibit 101 the Moore County lateral crossing to which I refer is about two miles northwest of the Fritch compressor station. All the gas from the Moore County area is required to pass across that river at that point before reaching the Fritch compressor station.

This is on the Moore County 24 inch lateral where it

crosses the Canadian River. This river is crossed with four 12 inch pipelines. Each line is approximately 7,000 feet long.

The Canadian River has a water shed or drainage area above the pipeline crossing of over 23,000 square miles. This drainage area is quite rough as to topography. The slopes are steep. It is semi-arid; which has been aggravated in the past few years on account of the drouth conditions in the southwest country. Rains, when they do occur, rapidly flow to the drainage areas and to the creeks, and hence to the main stream, the Canadian River.

It is not uncommon to see a flood approaching down the channel in the wall of water stage. By that I mean there is a distinct wall of water three to four feet in height. Preceding this approaching flood you will observe a boiling of the sand, as there is a very strong subsurface flow. The total depth of the sand in the Canadian River channel has never been found. There is a stratum of sand approximately 25 feet in depth, which is known as floating sand. This stratum is completely saturated with water during flood conditions. The sand moves en masse downstream during heavy flood. The force of this moving body of sand is sufficient to shear off bridge piers, piling, power line poles, break pipelines, and do damage of that character.

By way of explanation I would like to cite for you
683 some of the damage that was done by the Canadian River in the vicinity of our pipeline crossing as a result of floods during May and June in 1937.

The stream at the top of the picture on Exhibit 92 is the Canadian River of which I speak. If you will refer to that photograph you will observe the route of the 24 inch pipeline running from the Fritch station northwest across the Canadian River. We are accustomed to speaking of it as the main trunk line rather than a lateral line. It runs to Moore County.

You can follow the back fill by that lighter line across the photograph. The line enters the river at the south bank at the point I am indicating on the picture, approximately two inches in from the righthand margin, and leaves the river on the north bank about one inch from the righthand margin.

As a result of these floods of 1937, the Canadian River Gas Company lost four 8 inch lines on May 29, 1937. This crossing is about three and one-half miles upstream from our Canadian River crossing. The Phillips Petroleum Com-

pany lost four piers of their pipeline bridge and other piers were damaged. This bridge carries a 24 inch line. The Phillips Company's bridge is three-quarters of a mile downstream from our main line Canadian River crossing. The Huber Petroleum Company's 16 inch single line failed during one of the first rises. This crossing is three and three-quarters miles downstream from our main line Canadian River crossing.

I have referred to downstream. So that the record will be clear as to what I mean by downstream, I will explain that the Canadian River flows from the southwest toward the northeast.

The Southern Union Gas Company's 4 inch line parted at the center of the stream. This crossing is located three miles upstream from our Moore County crossing.

The Phillips Petroleum Company lost an 8 inch and a 12 inch line crossing the Canadian River near Sanford, Texas. These lines were located two and one-half miles downstream from our main line crossing.

The Rock Island Railroad Company's bridge near Sanford, Texas, was damaged to the extent of 250 feet. That is, 250 feet of bridge was washed out, and numerous piers were weakened. This bridge is downstream from our main line crossing. It is near Sanford, Texas, which is about a mile east of our Canadian River main line crossing. The Rock Island bridge is about two and one-half miles downstream from our main line Canadian River crossing.

There was additional damage done during the same floods on other streams in that same area, which I will not take time to detail now.

I wish to refer to a pipeline break which we had on the main line crossing of Canadian River in August, 1935.
684 We had Line No. 5, which is the fifth line counting from the downstream side, break. This line completely failed and broke in two at the north bank during a flood which reached a height of about eight feet.

We have checked the movements of the lines at the Canadian River main line crossing, and they have settled to depths of 15 feet and have moved downstream to the extent of 20 feet. On the Moore County crossing the downstream movement of the 12 inch lines has amounted to eight feet, the vertical movement to six feet. These movements are caused by the forces of this stratum of floating sand, which is approximately 25 feet deep.

When these lines move downstream there is a cold work-

ing of the metal which takes place. I mean that when a piece of metal is bent or deformed above the yield point of the steel, a new yield point is obtained. With each successive movement or cold working of the steel there will continue to be a new yield point until ultimately that yield point will reach the tensile strength of the metal. As each successive yield point is reached, the metal becomes more brittle, that is, more subject to fatigue, due to the vibration of the floating sand and of the water. This fatigue condition will eventually cause complete failure of the steel. Fatigue is caused by varying forces applied gradually, not by impact; and the resulting loads will cause the metal to fail at amounts of one-half to two-thirds less than the ultimate strength of the steel. If these variations in load are increased, and the repetitions are increased, the metal will fail at loads less than one-half of the ultimate strength of the steel.

I would like to cite a few examples of fatigue or the development of fatigue. I will assume first a sixteen gauge steel wire held between two hands. We have very frequently wanted to break a piece of wire in two pieces by bending it back and forth. If we bend this wire at small angles of deflection at a slow rate of speed, slow reversals, it will take some time for that wire to fail. We soon get tired of that and we speed up the operation. We increase the angles of deflection and increase the speed or number of reversals, and the wire will soon fail. If we take the same wire and attempt to break it by tension, it would be impossible for a human to do it without superhuman strength.

The cracks which appear in the fenders of our automobiles are the result of fatigue. We frequently read of railroad wrecks which are attributed to or caused by a break in the rail. This break is caused by or is the result of fatigue. The rail contains a flaw or defect from the time of its manufacture. The defect progresses or grows by the continuous travel or pounding on the rail by the wheels of the trains which pass over the track. The result is ultimately the broken rail.

To show how little a force may be to cause metal fatigue, it is known that the water dripping from a drainpipe in a railroad car into the axle of a truck will ultimately cause that axle to fail.

These examples are given to show and to explain the

forces which are continually working on these submerged crossings.

685 As stated, the Moore County crossing is now laid with four 12 inch lines. At the time of its original construction in 1931, we made provisions for the installing of two additional 12 inch lines. The header and gate valve facilities are now in place. Due to the additional drilling which is scheduled to be done in Moore County and the additional amount of gas that will be delivered from the Moore County area, in 1940 we are going to lay two additional 12 inch lines. These lines will not only serve as additional protection to this crossing, but will also reduce the pressure drop which now exists at that place. We contemplated these two additional lines at the time we constructed this crossing, and provided for additional spaces on the header.

The next item is No. 5, entitled "Replace Drips, 24 inch Line," with expenditures in the years 1940 to 1954, inclusive. A drip is a facility for the collection and removal of condensate from a gas pipeline. The drip to which I refer consists of a tank 18 inches in diameter which is placed directly beneath and parallel to the center line of the 24 inch pipe. This tank is connected to the 24 inch line by means of two 10 inch vertical risers. By risers I mean 10 inch pipe. The ends of each of these two pipes are welded respectively to the tank and to the 24 inch line, the bottom of the 24 inch line. These 10 inch welds are reinforced with gusset plates.

(At this time counsel for defendants presented a document containing three photographs, the top one being labeled "Drip With Gusset Type Weld Reinforcement," one entitled "Split Steel Welding Sleeve Installed on 24 inch Coupling," and another, "Illustration of Gusset Plate Reinforcing; Not a Part of a Drip." At the direction of the Examiner, this document was marked Exhibit 106 for identification.)

The picture at the top of Exhibit 106 gives the end view of a drip. The drip is placed on its side. The pipe to the right of the picture represents the 24 inch line. The pipe of which you see the end at the left of the picture represents the 18 inch pipe. The pipe connecting these two pipes is the 10 inch pipe. At each end of the 10 inch pipe is a triangular shaped plate. This is known as the gusset plate. Four of these plates are installed at 90 degrees around the periphery of the 10 inch pipe.

This gusset plate can be better observed by referring to the lower right hand picture on Exhibit 106. That shows the method of welding the gusset plate to the riser and to the pipe. These drips are continuously subjected to fatigue, which has been previously explained. The purpose of the gusset plate is to reinforce the pipes where they have been weakened as the result of the removal of a section of pipe from the tank and the 24 inch line.

We will assume an 18 inch tank closed at the ends with ellipsoidal heads with pressure applied on the inside. There are circumferential lines of stress running around the pipe. There are also longitudinal lines of stress running from end to end. We cut a hole in the pipe for welding a 10 inch riser. A 10 inch piece of pipe is welded to the opening and is closed at the opposite end. These
686 circumferential lines of stress as they approach this opening separate and follow the edges of the hole. In other words, those lines of stress are concentrating at the edges of the hole which has been formed, and in a similar way the longitudinal lines of stress are separating and concentrating at the edges of the hole. The pressure down in that drip is the same as the pressure in the pipeline itself, and also in the 10 inch risers to which I have referred.

There is a continuous deformation of this metal due to the pulsating flow of the gas. That is, the metal is continuously working at the points where the gusset plates are welded to the pipe. We have actually had failures occur in headers at the Fritch compressor station and also at Station 6. We have a program for removing and replacing these drips in the gathering system on account of this fatigue and on account of external corrosion.

In 1940 we will replace three drips amounting to $3,673 and in the succeeding years, from 1941 to 1954, inclusive, we have a continuous program of replacing drips on the 24 inch trunk line of the entire gathering system. The drips which will be constructed to replace the present drips will be so designed as to be reinforced with a steel welding saddle.

(At this point counsel for defendants presented a document containing two pictures, the top one of which is entitled "Drip with Saddle Type Weld Reinforcement," and the bottom picture being entitled "Welding Saddle Reinforcement." At the direction of the Examiner, this document was marked Exhibit 107 for identification.)

Both of the pictures on Exhibit 107 represent the saddle type construction to which I refer. In the upper picture the two large pipes in the center of the picture connected with two smaller pipes represent a drip of the type with which we intend to replace the gusset type of drips. The lower picture is a close-up view of the saddle reinforcement.

(At this point EXHIBIT 107 was offered and received in evidence without objection.)

The replacement cost of these drips varies from $1,191 to $1,291, installed complete.

Line 6, entitled "Replace lateral drips," shows expenditures from 1946 to 1954, inclusive. The lateral drip is a drip installed in the lateral lines. These lateral lines vary in size from four inches to ten inches, and when I refer to lateral lines I mean to distinguish from the 24 inch trunk gathering lines to which I referred a moment ago. The lateral lines are the smaller lines leading off from the main trunk gathering lines to the wells or to groups of wells.

These drips are constructed with 18 inch pipe closed at each end with an ellipsoidal head. They are installed in a vertical position in the pipeline—in the lateral line.
687 The lateral line is welded to the upper portion of the drip. These drips are installed in low swales, in creek areas, so that the condensate which is flowing along the bottom of the pipe line in a liquid phase will drop out by gravity into the drip tank, from which it will be later removed by the chart changers or line walkers.

By necessity, these drips are located in areas which are subject to accelerated corrosion. Due to the corrosive action at these locations on the metal surface of the drips, we are going to replace these drips beginning in 1946 and ending in 1954. The expenditure in 1946 will be $1,418, which will include 12 drips. I have referred to the difference in cost, ranging from $1,191 to $1,291. The difference in cost accounts for the little variation in the figures shown. In 1944, $1,266 is for one drip. That is another point that I did not observe before. That little variation in cost is explained by the expense of excavation.

I have referred to corrosion and its effect on the pipeline. Corrosion is the physical loss of the weight of metal caused by uniform or non-uniform oxidation, commonly known as rust. This corrosion is aggravated by the galvanic action of the soil and pipe and by stray electrolysis.

(At this point counsel for defendants presented a piece of steel about six inches square. At the direction of the Examiner, this piece of steel was marked Exhibit 108 for identification.)

The piece of pipe metal referred to as Exhibit 108 was removed from the main 24 inch pipe line at the highway crossing north of the Arkansas River crossing east of Dodge City, in Kansas. The smooth part is that portion of the pipe which was inside the 24 inch coupling. The rubber of the coupling extended over this part which has not been affected by corrosion; that is, from the smooth edge about two inches to where we see a depression in the metal.

The remaining portion of the pipe, of which this is a section, was corroded to depths of approximately one-eighth of an inch. The remaining metal thickness is about three-sixteenths of an inch. At the time this was removed from the line we removed 45 feet of 24 inch pipe. The bottom segment of this pipe was corroded in a similar manner as is shown on this sample. We are continually inspecting railroad and highway crossings to determine the extent of corrosion. There was no break at this point. That condition was found as the result of one of our regular inspections.

That condition in the pipe presents a hazardous situation with reference to the pipe line. That corrosion is caused by galvanic action aggravated by the presence of water, and is more commonly known as the electro-chemical corrosion. The hazard is, we may explain, twofold. A failure of the pipe would result in a serious interruption of the flow of gas, and a failure of the pipe at that location, being adjacent to a highway, could result dangerously to traffic on the highway.

We have found through our inspections that the pipe coating has not been resisting the effects of corrosion
688 as well as it should. The operations of constructing a highway or railroad crossing are such that it is difficult to construct a crossing and maintain the full value of the protective coating, so we have paid particular attention to the crossings. We make inspections of the rest of the line as well.

This is a typical case of corrosion. That condition is more or less local along the pipe line. It does not exist continuously. When corrosion starts, it will progress, but not in a straight line curve. The rate of progression

depends entirely upon the local and specific conditions that exist at each point along the pipeline.

I have completed my explanation of Item 6, and will proceed to Item 7, entitled "Install Tank Drips on 24 Inch Line," and showing expenditures from 1940 to 1952, inclusive.

At the time the 24 inch main trunk line was constructed in the Texas Panhandle in 1931, we made provisions for the installation of what we termed tanks. A tank is a reservoir which is constructed out of pipe, with the ends closed, with ellipsoidal heads. During the course of operating the gathering system we developed, through operating experience, that condensate will accumulate at points where no means for removing the condensate have been provided. At those places we install tank drips, and they are only installed at such times as we determine condensate is actually accumulating at those respective locations.

Beginning with 1940, we will install tank drips to and including 1952. The expenditure of $252 in 1940 is for the installation of two tank drips. The cost of one tank drip, completely installed, is $126. The amount varies with the number of drips installed. In 1945, 1946 and 1947 there will be three tank drips installed in each of those years, which will make a total of 29 tank drips installed during the 13 year period.

Item 8 is for installing new drips and tanks on lateral lines. It shows expenditures in 1943 to 1952, inclusive. My explanation for the installation of those drips is the same as that concerning Item 7 except that there will be additional condensate to be removed from the lateral lines as the field becomes older and the individual wells produce more water and moisture.

Question by the Examiner.

These figures represent tanks to be installed at five locations on the lateral lines, and 160 new drips will be installed on the respective lateral lines.

Direct Examination by Mr. Hedrick.

The expenditure of $1,880 in 1943 includes the construction of 16 new drips during 1943. The same number will be installed in 1944, 1945, 1951 and 1952. During the years

1946 to 1950, inclusive, we will install 16 new drips and one tank drip in each of those years.

689. Item 9 covers meters and regulators. These will be installed during the years 1939 to 1951, inclusive. Each time that a gas well is completed, it is necessary to install an orifice gauge meter and a regulator. The meter is used for recording the flow of gas from each well. The regulator is used for reducing the lateral line pressure to a four ounce pressure for the furnishing of gas to a heater which is installed on the inside of the meter house. This heater is used in the winter months to protect the meter gauge lines from freezing, which, if they did, would give an erroneous meter reading or registration.

The number of meters and regulators to be installed will be the same as the number of wells to be drilled in each of the years 1939 to 1951, inclusive. This is with the exception that in 1942 we will drill 20 wells but only purchase 15 meters and regulators. This is due to the fact that in 1942 we will reclaim five meters and five regulators which are now in service and which will make those facilities available for further installation. By referring to Exhibit 100 one could tell the number of meters and regulators that will be installed, since they are in harmony with the number of wells that will be drilled during the years in question, except for the year 1942.

Referring back to lateral drips, Line 6, and tank drips, Line 7, on the gathering system the gasoline has not at that time been removed from the gas, so there will be a larger amount of gasoline and moisture in the line at those points than after the gas leaves the Fritch station.

The unit price of those meters and regulators is $151, and you can tell by using that divisor how many are installed. In Line 9 on page 3 of Exhibit 105, starting with the year 1939, the number of meters and regulators to be purchased is as follows: 22 in 1939; 20 in 1940; 20 in 1941; 15 in 1942; 20 in 1943; 20 in 1944; 18 in 1945; 19 in 1946; 18 in 1947; 16 in 1948; 12 in 1949; 9 in 1950; and 1 in 1951.

Item 10, page 3, of Exhibit 105 is entitled "Skellytown Camp." Under that item we propose to construct a camp for the housing of personnel and equipment for the operation and maintenance of that part of the gathering system which is and will be in the vicinity of Skellytown, Texas. As additional wells are drilled and booster stations are in-

stalled, it is necessary to place our employees and equipment closer to the vicinity of their actual work.

In 1942, in Skellytown, we show an expenditure of $18,580. The detail of that expenditure includes the following: one house for a meter inspector; one house for a chart changer; a four car garage; the purchase of a camp site; the completion of a water well and installation of pumping equipment; an elevated water tank; a septic tank; and a pipeline warehouse.

In 1943 the expenditure of $746 is for the installation of pipe rocks for storing a supply of pipe. The expenditure of $19,433 at Skellytown in 1944 will be divided as follows: one house for a foreman; one house for a truck driver; two houses for maintenance men; six garage stalls; and recreation facilities.

690

In 1947 we have an expenditure of $5,547 at the Skellytown camp, which is for the construction of one house for a maintenance man and the construction of two garage stalls.

In 1948 we have an expenditure of $10,043 at Skellytown for the construction of one house for a maintenance man, one house for a chart changer, and two garage stalls.

The recreation facilities item on line 10 includes such facilities as a tennis court, croquet court, or teeter-totters for children. The amount involved for recreation facilities is $350.

Line 11 on page 3 of Exhibit 105 refers to the construction of houses and facilities at the Dumas camp, located adjacent to the town of Dumas, Texas. The reasons for increasing the facilities at the Dumas camp are the same as have been explained for Skellytown. In 1940, at Dumas, we have an expenditure of $36,061, which includes the construction of the following: a house for a foreman; one house for a truck driver; two houses for maintenance men; one house for a meter inspector; one house for a chart changer; a ten-car garage; three bays added to the present warehouse; a water well and complete pumping equipment; an elevated water tank; and recreation facilities in the amount of $350.

In 1942, at the Dumas camp, we have an expenditure of $4,655, which includes the construction of one house for a maintenance man, one garage stall, and the purchase of additional land at a cost of $163.

In 1943, at the Dumas camp, we have an expenditure of

$4,429, which includes the construction of one house and one garage stall.

In 1945 we have expenditures totaling $5,299 for the construction of one house for a chart changer and three garage stalls.

In 1946 we have an item of $4,080 for the construction of one house for a maintenance man.

In 1947 we show an amount of $4,757 for the construction of one house for a meter inspector and two garage stalls.

Line 12 on page 3 of Exhibit 105 is described as Kingsmill Camp. During 1943 we have an expenditure of $5,337 for the construction of one house for a chart changer and a two-stall garage.

Item 13 is entitled "Cathodic Protection," and shows expenditures in 1941 and 1942. Cathodic protection is an electrical method for preventing the corrosion of metal by impressing a negative potential on the pipe with respect to the soil or some other structure. That cathodic protection is on account of either electrolysis or electro-chemical action. When pipe is corroded by either of those, the corrosion is due to the current flowing from the pipe.

691 The pipe is positive to the soil or some other structure.

The cathodic method is for the artificial reversing of the flow of current. The equipment that is used is a power-driven generator. The power may be supplied by a gas engine or a windmill, or the power can be purchased from some electrical transmission line.

We will assume, for example, the installation of the windmill type of equipment. A unit of this kind is installed on a tower similar to a windmill tower. A ground bed is installed at a point remote from the pipeline. The current flows from the generating unit to the ground bed, thence to the pipe; that is, there is always a continuous flow of current from this ground bed to the pipe.

We have an installation of cathodic protection which is being made at the present time on a five-mile section of 24 inch line near Wilson, Kansas. We will have sections of the line, each section being one mile or more in length, located in concentration areas wherein cathodic protection will afford an economical method for arresting the action of corrosion. We have had experiments made and studies prepared in the past showing that electrolysis or electro-chemical action does exist and that this method is an efficient method for protecting the pipeline against such action.

Questions by the Examiner.

We plan to generate our own power. The figure in 1941 is for the purchase of equipment for the protection of 3.8 miles of lateral line and two miles of 24 inch pipe line. It will consist of the wind driven generator, tower, ground bed, necessary wiring, and, in the case of the 24 inch pipe line, the copper bands which are installed at each coupling. They are welded to the pipe on each side of the coupling to provide for a continuous flow of current, thereby reducing the resistance of the pipe. We have not yet specifically located those sections; but we have determined their length from a study that we are making at the present time and work that we have done in Kansas during these last few years. That length is the result of those studies, based on a percentage of the amount of pipe installed. Those sections which are referred to here will be in the gathering system in the Panhandle field in Texas.

Direct Examination by Mr. Hedrick.

The equipment involved in the expenditure in 1942 is the same and we plan to protect a similar amount of pipe. It will still be in the gathering system in Texas.

On page 3 there are two other sub-heads, namely, "Book Cost of Property Retired" and "Salvage." Those are the amounts set out opposite each of the lines under those sub-headings shown on page 3. For example, in 1942, under the heading of "Book Cost of Property Retired," Item 1, lateral lines, we show a property retirement of $7,500. In the same year under the heading "Salvage" there is an item of $1,800. That is the salvage that is involved in the taking up of the lateral lines involved in the construc-
692 tion of lateral lines in Line 1 under the heading "Additional Capital Expenditures," and refers to the book cost of the usable material.

(At this point EXHIBIT 108 was offered and received in evidence without objection.)

The information as to the stations to be installed and the units added, shown on page 4 of Exhibit 105, was obtained from Mr. R. M. Bussard, and is the information that is contained in Exhibit 100. Those booster stations are spotted on Exhibit 101 and are designated by solid red triangles.

The term "Stations Installed" means the construction

of a building and the installation of an engine driven compressor unit. The term "Units Added" means the unit or units that may be added to the original station installation. The first line on page 4 of Exhibit 105 gives the number of stations to be installed in each of the years there shown. The second line indicates the number of engine driven compressor units that are to be added to the respective stations. When I say "Units Added" it means the same as the engine with its compressor unit referred to by Mr. Bussard. The terms are synonymous and refer to a 40 horse power complete unit. "Stations Installed" and "Units Added" compare to the "Stations Installed" and "Units Added" shown in Mr. Bussard's Exhibit 100. In other words, in 1940 there will be two stations installed in addition to the station that is now installed; and in 1942 an additional 12 stations will be installed, and in one of those stations an additional unit will be added, so that at one of the stations you will have the housing and contained in that housing will then be two units.

I have been requested to explain how I arrive at the cost of the stations installed and units added, and how much each unit costs as of June 1, 1939. In the year 1940 we have an expenditure of $10,640 for the installation of two stations. The unit cost of a station installed complete is $5,320. Using that unit cost as a factor, the figures in the first line on page 4 will give the amount of money to be expended under the item "Stations Installed" for each of the years shown. In 1940 the two stations will cost $5,320 each, and in 1942 there will be 12 stations installed at a cost of $63,840. The balance of the line is simply a multiple of $5,320. The units added, of which there will be one in 1942, will each cost complete $4,675. The other amounts set opposite that line are units costing $4,675.

In 1942 we will install an 8,000 gallon lubricating tank, amounting to $1,051, at Skellytown, which is the same Skellytown camp I have already referred to. In 1944 we will install a lubricating oil tank, 8,000 gallon capacity, at an expenditure of $1,051, at the Dumas camp. These tanks are installed for the purpose of purchasing lubricating oil in bulk quantities in order to take advantage of minimum purchase prices, and the oil so purchased will be stored in these tanks.

Under the heading "Book Cost of Property Retired" it is shown that 25 units will be retired in 1952, the book
693 cost of which is $116,875, and under the sub-heading

"Salvage" $99,875 thereof will be salvage. That figure merely represents the book cost of the usable material salvaged.

Cross-Examination by Mr. Slaff Interposed.

Those materials will be reinstalled in the same year at other locations. Those 25 units will make up part of the 37, and 12 additional units will be purchased. The difference between the amount of $99,875 salvage and the $116,875 book cost, comprises such items as labor, transportation, freight, and incidentals. In this case the book cost of the units happens to coincide with the installed price as of June 1, 1939.

Question by the Examiner.

I have been asked to explain how I correlate Item 4 under "Book Cost of Property Retired" and Item 4 under "Additional Capital Expenditures." The book cost of property retired, consisting of the two 12 inch Canadian River lines in the years 1945 and 1947, respectively, is $34,816 in each of those two years; that is, the book cost of the two original lines which were constructed in 1931. That does not refer to the two lines which we are going to construct in 1940. We are not reclaiming those lines in 1945 and 1947.

Direct Examination by Mr. Hedrick.

The reason that the two lines that will be constructed across the Canadian River in 1940 cost so much more than the book cost of the two lines to be retired in 1945 and 1947 is because of the increased cost of material, the increased cost of labor, and the increased cost due to the fact that the overhead and equipment is distributed over a considerably shorter section of line. During the construction of the gathering system one contractor had the entire gathering system, and he was able to distribute all of his overhead expense and his equipment expense over the entire project. In this case, in 1940, it will be necessary for a contractor to bring in men and equipment and organization specifically for a small amount of footage. Also in that figure there is expense for a more substantial design than we had in the lines that were constructed in 1931.

Questions by the Examiner.

These two 12 inch lines are on what we term the Moore County crossing. We do not plan to replace the two lines which we are retiring. The additional capital expenditure item represents somewhat an anticipation of the retirement of those two lines plus whatever operating benefit we gain by putting them in at this time.

Direct Examination by Mr. Hedrick.

The new lines will not be laid at any greater depth than the present line.

694 *Cross-Examination by Mr. Booth Interposed.*

My working papers will not disclose what items have been included in the book cost of the property to be retired. That data must be obtained from the accounting department. That information was furnished to me by the accounting department, and I do not myself know what is included in it. I am not in position to state specifically what is included in the book cost of the items of property retired.

Direct Examination by Mr. Hedrick.

In other words, when I retired the two Canadian River lines I went to the accounting department and was advised by them as to the cost of these two lines that were installed, and I used that figure in my retirement item. That applies with respect to the retirement throughout this exhibit.

Cross-Examination by Mr. Booth Interposed.

I am not able to answer for the accuracy of the book cost items. Those books are in the hands of the accounting department.

Cross-Examination by Mr. Slaff Interposed.

The price as of June 1, 1939, which I used for drips on the 24 inch line is about 100% more than the book cost of the drips which are replaced. When we retire equipment,

the equipment is retired at the book cost. The reason that the book cost coincides with the cost for additions as of June 1, 1939, is that there are no additions until on and after June 1, 1939. In other words, there have been no booster stations installed to date outside of an experimental station. Book cost is the original cost of the item.

Direct Examination by Mr. Hedrick.

I now pass to page 5, entitled "Pipeline Department, District No. 2." The first item, "Install Six-Inch Blowoffs," is a pipe connection welded to the top of a 24 inch line and is used for the removal of gas from the line and for the purging of a section of line following a time when the line has been taken out of service for some repair. These blowoffs will be installed at three different locations, one on each side of the main line Canadian River crossing and one on the inlet of the Texoma sales meter near Gray Junction. Each blowoff will cost $346 installed.

I have already stated the necessity for replacing drips in connection with Sheet 3. The necessity for the replacement of these drips is the same as I testified concerning line 5 on page 3. One drip will be replaced in 1940 and one drip in 1941.

The third line is "Replace Headers." The lower picture shown on Exhibit 79, introduced through Mr. Floyd C. Brown, entitled "Typical Manifold for Submerged Pipeline River Crossing," showing a valve assembly and header connection for 24 inch main line, shows the construction of a typical header, which we term a 24 inch by 12 inch six run header. We have headers of different sizes, depending upon the number of multiple lines constructed across a stream. The very short line leading from the left side of that picture is the 24 inch line, and that is connected 695 onto another 24 inch line, out of which emerge six smaller lines, on each of which is a valve. That is a typical header installation.

As to the necessity for the replacement of the headers in 1940 and 1941, shown on page 5 of Exhibit 105, I have already described in my testimony the effect of corrosion on drips and the fatigue of metal as a result of gusset plate construction. These same factors are applied in the same way in discussing deterioration of headers.

There are additional factors, however, which are working toward the destruction of river headers. There is a continuous pulsation which comes from the operation of the

compressor station. That pulsation causes a variation in line pressure, which in turn creates vibration which actually accelerates the fatigue action. The expansion and contraction of the river lines due to temperature changes is dissipated normally in the sinuosity of the lines. At the ends of the river lines, where they are attached to the respective headers, this expansion and contraction due to temperature changes is dissipated in the header, resulting in deformation of the header, which is also contributing toward the physical destruction of that header.

There is another factor which is working on the header, and that is the weight of the gas which passes the header every 24 hours. The approximate weight of this gas is 5,250 tons. I have figured that on 210 million cubic feet per day. At a pressure of 14.65 pounds and a temperature of 60 degrees, 1,000 cubic feet of gas will weigh slightly more than 50 pounds. In my calculations I have used 50 pounds.

The gas as it passes through these headers has a change in direction. In fact, it changes in direction twice, two complete 90 degree changes.

We do not normally think of gas as having weight, and I would like to give one or two examples. This weight is equivalent to a 100 car freight train, each car loaded with 52½ tons of material. Another example is that a stream of automobiles would involve 3,500 cars passing over the header each 24 hours, traveling at the rate of 14 miles per hour. That is only by way of explanation in order to better visualize that there is weight passing through that facility.

The change in direction of this tremendous weight of gas causes part of the vibration in the header.

For the reasons I have enumerated, we plan to replace a header in 1940 at a cost of $2,805 and a header in 1941 at a cost of $2,322. That difference in cost is due to the fact that there is a difference in the design of each of the two headers. The reinforcement of the welds on the headers that were originally installed was the gusset type reinforcement, and on the headers that will replace the present headers the saddle type will be used. On all construction work which we have done since the completion of this line, the saddle type of reinforcement has been used. It was not available at the time of the construction of this pipeline.

One of these headers will be at the main line Canadian
696 River crossing and one at the Moore County check meter, near Gray, Oklahoma.

Item 4 is "Install 12 Inch Loop Lines," and shows expenditures in 1940 and 1941. A loop line, as I shall use the term, is a pipeline designed to be laid across a stream or an overflow area, or a combination of the two. This line will be laid parallel to the present 24 inch line and will be so installed with gate valve facilities that either of the two lines may be removed from service in the event of failure of one of the lines. 24 inch valves will be installed as block valves in the 24 inch line. Block valves or gate valves are used to stop the flow of gas, to take a section of line out of service.

In the installation of these block valves it is necessary to install a concrete anchor in close proximity to each valve. When a valve is closed with pressure against the closed valve, there develops an enormous total pressure against that closed valve, the amount depending upon the prevailing pressure in the pipeline. For 700 pounds it is in the neighborhood of 300,000 pounds which is tending to push that valve off the line, or rather, it is a thrust rather than a pressure. A thrust is the result of this pressure force.

So that to protect that facility from blowing off the line, so to speak, we install these concrete anchors, which will prevent the movement of the valve when it is in the closed position and a force is acting against it. I am confining myself to Item 4 and am not referring to Item 5.

Questions by the Examiner.

There will be a valve on the loop line itself. For example, for a 12 inch loop line there will be a 12 inch valve installed at each end of this loop line just ahead of the respective connections to the 24 inch line. These loop lines are installed across streams and overflow areas which are susceptible to heavy washing, and those that are inaccessible.

Assuming that we will have a pipe line failure in a 24 inch line with no auxiliary protection in an isolated location, we would have a serious interruption of service, and this is a reinforcement or insurance against the interruption. The loop line construction is a continuation of a program which we have been carrying on. Some of the loop lines that have been heretofore constructed after the original installation are also shown on page 18 of Exhibit 105.

The loop line in 1940 will be constructed at Survey Sta-

tion No. 605 plus 88. This is a branch of Kit Carson Creek. This survey station is shown on Exhibit 103 on the first line. The second loop line in 1941 will be constructed at Survey Station No. 654 plus 51 and is also indicated on Exhibit 103. These two branches of Kit Carson Creek are unnamed, and that is the reason for designating them by the station number.

Direct Examination by Mr. Hedrick.

In 1940 we have an expenditure of $2,711 for the installation of welding sleeves and concrete anchors. This work will be done at a third branch of Kit Carson Creek at Survey Station 459 plus 78. This work will be done to
697 reinforce the 24 inch line across this creek by making it more stable and more resistant to the buoyancy of the water under flood conditions. This is also a continuation of work which we have done at various points on the pipe line.

The sixth item is "Lay Six New Lines, Canadian River." I have already testified as to the conditions at Canadian River, and the only additional reason I desire to add is the fact that at the point at which we cross the Canadian River on the main line, the width of the channel is about one-half the width of the channel where the Moore County crossing crosses the Canadian River. This increases the velocity of the water flowing, the depth of the water flowing, and the subsequent increase in force of the moving body of sand.

Those are 12 inch lines. We have six 12 inch lines across that river at the present time, and the six new lines will be laid as a complete new crossing. There are certain improvements that have been made in the construction of river crossings, and these improvements will be incorporated in the construction of the new crossing.

Line 7 is entitled "Cathodic Protection." Cathodic protection has been previously described and will be used in District 2 for the protection of the 24 inch main line. Approximately two miles are involved in each of the two years.

The book cost of the property retired and the salvage are shown at the bottom of page 5.

Question by the Examiner.

The plan is to lay three of these new lines across the Canadian River in each year. The reason for that is that we are limited as to the time during the year in which construction can proceed.

Direct Examination by Mr. Hedrick.

One of the counsel asked me a question with reference to the book cost of property retired on page 3 of Exhibit 105, being Item 4, "Retire Two 12 Inch Canadian River Lines," and inquired whether or not I had a breakdown of the retirement of $34,816 set out in each of the years 1945 and 1947. I told him I did not, but that I would get that information from the accounting department. I wish to make a statement with reference to that.

After having time to review my detail sheets, I found that I had those items shown under 1945 and 1947 in detail in one of my work books for the retirement of two 12 inch Canadian River lines, and I will be glad to review the details with counsel.

Page 6 of Exhibit 105 is entitled "Pipeline Department. Additional Capital Expenditures and Book Cost of Property Retired—Tools." The replacement of equipment to which I will subsequently refer will be done from time to time. The reason for these replacements is due to the 698 fact that by continued use the equipment is wearing out and deteriorating to the point where it is no longer advisable to continue its use at the time the replacement takes place.

We are also going to purchase additional equipment. The reason for that is that as the property becomes older there is more work of a remedial nature to perform, which will require the added equipment in connection with those repairs. There will be more maintenance to be performed in the future than there has been in the past because any structure that gets older with age requires more maintenance to keep it in operation. This pipe line structure is practically all a sub-surface structure, and, in addition to the normal wear and tear of the structure, it is subject to the destructive forces of corrosion.

The first item is "Melting Kettles." These kettles are used for the heating and melting of the pipe coating material known as enamel, which is applied to the pipe and other

sub-surface structures for the prevention of corrosion. In 1941 we will replace two kettles, both of which were purchased originally in 1931.

Item 2 is a 3P Jaeger centrifugal pump. This pump, along with the following pumps which will be referred to, is used for dewatering trenches, bell holes, or at any point where it is necessary to move water before repairs or remedial work can be done. A bell hole is a large opening excavated around the pipe to permit one or more workmen to perform their duty in connection with making repairs. In 1943 we will replace a Jaeger which was purchased in 1935. These are all portable pumps. The Jaeger pump is a gasoline engine driven pump. The bell holes I refer to are similar to the bell holes which were dug, to the extent of 100 or more, when Mr. Biddison, accompanied by Mr. Johannigsmeir of the Federal Power Commission, inspected the pipeline for visible depreciation a short time ago. They are the same type of excavation.

The next item is electric welding machines. Those are gas engine driven direct connected generators, used for the application of the electric arc in making what is called an electric weld. In 1942 we will purchase an additional machine. In 1943 we replace the machine which was purchased in 1937. In 1948 we replace the machine which was purchased in 1942. In 1949 we replace the machine that was purchased in 1943.

I notice I have overlooked two melting kettles and a Jaeger pump in 1951. In 1951 the melting kettles will be replaced which were purchased in 1941 and the Jaeger pump will be replaced in 1951 which was purchased in 1943.

The next item is a 4-inch Rex pump. This is a gas engine driven centrifugal pump. 40-M means the capacity is 40,000 gallons per hour. It could be used for oil, but we use it for water. In 1946 we will replace the pump that was purchased in 1938.

The next item is a 6-inch Rex pump of the same type, 699 except a larger capacity pump. It is a 90,000 gallon per hour pump. It was purchased in 1938 and will be replaced in 1946.

The next item is a rotary scraper. A rotary scraper is a piece of equipment similar to the Fresno, which we see used in construction jobs, road construction, railroad construction, or any excavation jobs. Practically the only difference between the rotary scraper and the Fresno is that the bucket can make a complete revolution when emptying

the material from the scraper. These scrapers are used in connection with trucks, principally with tractors. This rotary scraper will be replaced in 1946. It was purchased in 1938.

Cross-Examination by Mr. Slaff Interposed.

According to the exhibit, a Jaeger centrifugal pump is to be installed or bought in 1951 to replace the 1943 pump. Counsel has inquired why the book cost of property retired, 3P Jaeger centrifugal pump in 1951, is $296 instead of $310, which was the book cost of that property in 1943. Apparently that is an error. It should be $310, just roughly checking it here now. The original pump that we purchased in 1931 will be replaced in 1943 and the book value or book cost of that pump was $296, and apparently an error exists by simply using that same figure for the pump that will be purchased in 1943. To be exact, it should be $310 under the year 1951.

Direct Examination by Mr. Hedrick.

The next item, a rotary scraper, is the same type of scraper but of heavier design, for a larger tractor, and will be purchased new in 1943. The purpose of that is to handle heavier excavations and more excavations as the property becomes older.

The next item is electric lighting units. These are gas engine driven direct connected generators generating 110 volts. They are used for the operation of the company's radio equipment and to furnish light for men working during emergencies or at night about the property. They are small portable units. The unit which was purchased in 1938 will be replaced in 1948.

I referred to radio equipment. We have equipped the north end of the pipeline system with portable telephone-radio equipment. We have transmitting and receiving stations at Station 6, Red Oak, Iowa, and at Stations 8, 9 and 10. We have receiving sets installed on trucks, superintendents' and foremen's automobile equipment.

This radio equipment was purchased primarily to facilitate the repair of this pipeline during emergencies, from a communication standpoint. We have found, and it has been our experience, that our pipeline breaks occur as the result of some natural force over which we have no control.

During those same periods communication systems are out of order. I am referring to floods, sleet, hail and tornado. The farm systems are not always adequate and are not reliable. Based on the experience we have had, we decided to use the radio equipment.

700. We have used this equipment several times since its installation in connection with shutouts and repair work that we have done on the line from time to time. In fact, last Sunday we had the line shut out at Grand River, which is in western Iowa, in District 5-W. This line was shut out for the installation of 24 inch gates and 12 inch gates for the connection of a 12 inch loop line which is just being completed. We have no company telephone communication in close proximity to that work. The telephone lines of the company do not follow exactly where the pipeline is across Iowa and Illinois. In Kansas they do not parallel the pipeline in a diagonal route. They do follow the section line roads, but zigzag across the pipeline across Kansas and Nebraska as far as Beatrice. At Beatrice, Nebraska, the telephone line is constructed on the Burlington Railroad right of way poles and from that point to Chicago the service is on the Burlington right of way.

During a shutout it is necessary for the dispatcher in the Chicago office to keep in close contact with the progress of the work. Obviously he is interested in when he will be able to return the pipeline to service for the continuation of the delivery of gas. The radio equipment is used to contact our stations on either side of the work, in order to keep them advised as to the progress of the work, to direct the activities of the men, and, if need be, to order additional material that may be required.

Question by the Examiner.

I said the farm systems are not so reliable. There are a number of telephone systems in the country that are not owned or controlled by the Bell Telephone Company, A. T. & T., or any of its subsidiaries. A group of farmers will combine and construct a telephone line in some local area for their own use. Those systems are usually constructed on very meager poles. Sometimes they follow the fence poles, and sometimes they are secured to trees along the fence line. They are not adequately maintained and they are subject to the elements or destruction more readily than the regular commercial lines.

Direct Examination by Mr. Hedrick.

We sometimes use those in getting a connection with the Bell system or our own system.

The next item is a one-half yard power shovel, dragline and pull shovel. This equipment is similar to the steam shovel type, except that it is gasoline engine powered. It is equipped so that a dragline can be used or a pull shovel can be used, depending upon the nature of the work to be performed. We are going to purchase this equipment in 1943 in order to handle the heavier excavations and remedial work on the pipeline that we will have to do in the ensuing years.

The next item is that of air compressor and tools. In 1946 we will replace an air compressor and auxiliary tools which were purchased in 1938. The air compressors are used for various purposes, such as rock excavation,
701 hard soil excavation, operating pneumatic tools, pneumatic motors and for excavating frozen ground.

The next item is a C. H. & E. diaphragm pump. C. H. & E. is just an abbreviation of the name of the company from which we purchased the pump. I don't have the name of that company here. It is a gasoline driven pump. We purchased that pump in 1937 and it will be replaced in 1945.

The next item is Goulds diaphragm pump, which is the same type of pump as the preceding one, and is hand operated. It will be replaced in 1944.

The next item, snow plow for trucks and caterpillar tractors, shows an expenditure in 1942 of $600 for snow plow equipment for a truck and a tractor. This equipment will be used for keeping the roads open in the gathering system so that the chart changers and men responsible for the operation of the booster stations will be able to carry on their duties in the gathering system. In 1943 we will purchase a snow plow for the tractor which is to be purchased also in the same year.

The snow plow is used for the removal of snow from the roads which exist through the gathering system. These roads have to be cleared to permit chart changers and maintenance men to cover their duties in the gathering system in connection with changing charts and maintaining and operating the booster stations in connection with the flow of gas. We haven't purchased the snow plows before because we haven't had satisfactory equipment on hand to use as a motive power for the snow plows. They can

be used to some extent with trucks, but not satisfactorily. We did not have the caterpillars until 1938.

The next item is a bull dozer for an R-4 caterpillar tractor. A bull dozer is a piece of equipment for back filling an excavation. It is mounted on the front end of a tractor and is used to push the soil or excavated dirt into the trench.

The next item is an acetylene generator. This is used for the generation of acetylene gas used in the acetylene welding process. Such a generator was purchased in 1935 and will be replaced in 1943.

Item 16 is for small tools, additions and replacements. We have a number of smaller pieces of equipment and tools costing in excess of $25 which are not detailed on page 6. $500 per year is to be used for the purchase of small tools as they become worn out and of no further use, and for the purchase of additional small tools as and when they may be required.

The book cost of the property retired and the salvage are also shown on page 6.

The four-inch and six-inch Rex pumps which we now have were bought in 1938.

702 Page 7 is entitled "Natural Gas Pipeline Company of America, Pipeline Department, Summary of Capital Expenditures and Book Cost of Property Retired." Under "Additional Capital Expenditures" Lines 1 to 8, entitled "District No. 3," "District No. 4," "District No. 5-W," "District No. 5-E," "District No. 6," "Branch Lines," "Joliet Meter and Regulator Stations," and "Tool Account," are shown more in detail on pages 8, 9, 10, 12, 13, 14, 15, and 16, respectively. Under the heading "Book Cost of Property Retired" Lines Nos. 10 to 17, inclusive, are set out more in detail on pages 8, 9, 10, 12, 13, 14, 15, and 17, respectively. Under the heading "Salvage" Lines 19 to 26, inclusive, are explained more in detail on pages 8, 9, 11, 12, 13, 14, 15, and 17, respectively.

Turning to page 8, I have already explained what a drip is and also what a river header is. I have no additional reasons for replacing drips to add to those which have been previously stated. For the years 1940 to 1945, inclusive, there will be one drip replaced in each year. I have no further information regarding river headers with respect to reasons for replacements.

The item of $3,418 in 1940 is for the replacement of two 18 by 12 inch headers. In 1941 the expenditure is for the

replacement of one 24 inch by 12 inch header, which is a six-run header. In 1942 it is for two 18 by 12 inch headers. In 1943 the amount is for the replacement of one 24 by 12 inch header. In 1944 the amount is for the replacement of two 24 by 18 inch headers. In 1945 the amount shown is for the replacement of one 24 by 16 inch header, which is a three-run header. In 1946 the amount shown is for the replacement of one 24 by 12 inch header and one 24 by 18 inch header.

With reference to Item 3 I have already explained what 6 inch blowoffs are. This item includes a number of 6 inch blowoffs represented by expenditures in the years 1939 to 1943, inclusive. The installation of a 6 inch blow-off costs $346. In 1939 four of these blowoffs will be installed; also the same number in 1940, 1941 and 1942. In 1943 there will be three 6 inch blowoffs installed.

Item 4 is "Install Two 16 Inch Lines, Beaver River," with an expenditure of $120,207 in 1941. Beaver River is located on Exhibit 103, and it is the third river named on the last horizontal line, third from the lefthand side of the exhibit. The crossing is located in Beaver County, Oklahoma, near the town of Beaver. This river is crossed at the present time with six 12 inch pipelines and one 16 inch line. On the north side of the river the six 12 inch lines are divided into two groups of three lines each. An 18 inch line connects each of these two groups of three 12 inch lines to the 24 inch main line through a 24 by 18 inch header.

Beaver River at the point of the pipeline crossing has a flood bottom from bank to bank of about 4,000 feet. That is not from bank to bank of the channel; it is from bank to bank of the entire flood area, the overflow area. This flood bottom during the first years of operation was well covered with vegetation. It was a meadow or
703 pasture. During the drouth years practically all of this vegetation was destroyed. Floods which occurred deposited sand on these flood bottoms, which further destroyed the remaining vegetation. The wind erosion and lack of water during this two or three year period resulted in the wind actually filling the main channel with dry sand. The flow was all sub-surface. Following that, when floods occurred, the channel overflowed the surrounding flood plain, due to the fact that the elevation of the bottom of the channel was at that time higher than many portions of the adjacent flood plain.

In 1937 we experienced a series of floods in that river, which formed a new channel to the north of the channel which existed at the time we constructed the pipeline. These floods also formed a new channel south of the old channel, and near or adjacent to the south bank. This cutting and erosion action resulting from the floods and the formation of new channels undermined the six 12 inch pipelines, which left them completely exposed to the forces of the river. As an emergency measure, in July, 1937, we lowered sections of the 12 inch lines at a cost of $22,000. That expenditure is shown on page 18 of this exhibit.

Major operations of that character are performed by our own personnel. We supplement our regular forces by the employment of additional men. That is with reference to the type of work which I described on Beaver River, which is more of an emergency character. In the construction of pipelines, loop lines, or the extension of lines, where we have time to design and plan the work, those lines are practically always contracted for.

After this experience on Beaver River we were firmly convinced of the necessity of providing some adequate protection and insurance for continuity of service at that stream. We designed and prepared specifications and secured contracts for the construction of a 16 inch pipeline to be laid entirely across the overflow area at a depth varying from ten to twelve or fourteen feet below the normal surface of the overflow area and the stream beds at that time. This work was completed in 1937.

That is shown on page 18 of this Exhibit 105 under District 3, the third item under that district, for work which was performed in 1937 at an expenditure of $69,698.29. At the time that line was constructed we installed header facilities for the installation of two additional pipelines, having in mind at that time that at some future date we would install two additional 16 inch pipelines.

We have recently experienced another flood of the Beaver River which again formed a new channel north of the north channel, which was formed in 1937. This new channel is gradually approaching the north two 18 inch by 12 inch headers. We are at the present time making an emergency expenditure to protect those lines from forces that will develop in this new channel.

In 1941 we have an amount to be expended for the in-

stallation of two 16 inch lines which were contem-
704 plated in 1937. If the flood conditions on Beaver River continue, we may be forced to spend that money at an earlier date.

As to whether a bridge would be practical at this Beaver River crossing, a bridge of the suspension type to be constructed at that location would require a clear span of at least 4,000 feet. We have not as yet seen a design for a suspension type bridge having a clear span of that distance that is satisfactory or acceptable to us for the carrying of a pipeline suspended across the entire flood area.

The next item is "Install 12 Inch Loop—Crooked Creek." Crooked Creek is shown on Exhibit 103, on the first pink horizontal line. The crossing is located south and a little west of Meade, Kansas, in Meade County. The creek at the present time is crossed with a single 24 inch pipeline. This creek is subject to overflow periods of as much as a week. A failure in the 24 inch line during one of these flood periods would result in considerable interruption of continuity of service. We have designed a 12 inch loop line to be constructed parallel to and connected to the present 24 inch line. This loop line will be 2,000 feet in length. The expenditure will be made in 1942, amounting to $28,444.

Item 6 is entitled "Install 15,600 feet—12 inch Extension—Arkansas River." The Arkansas River is crossed with six 12 inch lines, that is, the main channel. The overflow area to the south is crossed with two 18 inch lines, and the overflow area to the north is crossed with two 18 inch lines. This river is located east of Dodge City, Kansas, and is shown on Exhibit 103.

This river is a characteristic stream of the streams in Kansas and in Oklahoma and Texas. That is, the stream bed consists of sand and the overflow area consists largely of sand. Whe are going to be required to recondition the six 12 inch lines across the Arkansas River. During this operation, or at the time the lines are reconditioned, they will be lowered a depth of six to eight feet and the river headers on each side of the river will be extended back by extending the six 12 inch lines.

This river is attempting to widen its present channel, following the same general action that has taken place on Beaver River which I have just described. It is for the protection of this crossing against any interruption of

service that we are going to extend the 12 inch lines and lower the 12 inch lines in 1943, at a cost of $139,227.

As to whether we now have any river work in progress such as I have testified about on Lines 4, 5 and 6, we have river work going on at the present time. We are lowering the 12 inch lines at the Republican River, on the south side of the Republican River, near Concordia, Kansas, in Cloud County. We are lowering the two 18 inch lines and extending the east 18 inch by 24 inch header on the east side of the Nishnabotna River.

We are constructing a 12 inch loop line at the Grand
705 River crossing in central western Iowa. You will find that name on the top horizontal line of Exhibit 104. We are lowering the six 12 inch lines across the Des Moines River in the central part of Iowa, near Tracy, Iowa. That covers the river work which is in progress as of the present time.

Item 7 is entitled "Raise Three-Inch Blowoffs." The three inch blowoff is the same type of facility as described for the six inch blowoff, except that it is a smaller size. They are installed on each end of each river line and are used for the purpose of removing gas from the river lines. These blowoffs are being raised. At the present time the piping and gate valve are below the elevation of the ground surface. The expenditure under 1939 involves 128 blowoffs, and that work is now in progress.

Item 8 is entitled "Install Gate Boxes." A gate box is a small galvanized corrugated iron building constructed on a steel framework and is used to completely house a main line valve or river valves at a river header. They are installed for the purpose of facilitating the operation of these valves during emergencies, to facilitate the servicing of the valves from the standpoint of lubrication, packing the stuffing boxes, and to protect the valves from the elements, such as ice, snow, sleet, and so on. That work is now in progress.

Questions by the Examiner.

These valves have not been housed in the past. We plan ultimately to house every valve. This program is a continuation of a program that has been going on for the past five or six years. We have all of the valves housed on the north end of the system, as shown on Exhibit 104.

I mean by that, all in Districts Nos. 5-W, 5-E, and 6. The expenditure in 1939 is to be made and is being made for the installation of gate boxes at the Cimarron River crossing, the Arkansas River crossing, the Saline River crossing, Willow Creek, Pawnee, Smoky Hill River, Beaver River, Walnut Creek, and Salt River.

Direct Examination by Mr. Hedrick.

Item 9 is entitled "Install Cathodic Protection," and I have already described what it is. The expenditure for 1939, in the amount of $5,154, is now in progress; that is, the work is in progress. That is for the cathodic protection of five miles of 24 inch line in the vicinity of Wilson, Kansas. We have additional sections of 24 inch pipe between the Smoky Hill River crossing and the Pawnee River crossing which will also be protected with cathodic protection in the years 1941 and 1942, respectively. There will be approximately four miles of line to be protected in each of those years.

The book cost of the property retired and the salvage are shown at the bottom of page 8.

Cross-Examination by Mr. Slaff Interposed.

The swage drains which I said were to be retired 706 are handled under maintenance expense and they are included in the operation and maintenance figures. They are originally in capital. The accounting department has a rule that when the item of investment is very small they do not consider it necessary to go through the mechanics of removing the items such as those swage drains from capital investment. The swage drain is all junk material.

As those swage drains are taken out of the plant and service, nothing is removed from the capital cost on account of those removals from plant, except that I should say that this pipe that is installed to replace the swage drain is, in a sense, a capital expenditure. In fact, such capital expenditure is more than the capital expenditure of the initial cost of the swage drain. The difference between the two items is comparatively small, and we do not make a charge and credit for capital as we do in items of considerably larger amounts. The pipe that

replaces the swage drain represents an amount approximately equal to or more than the cost of the swage drain. The cost of the pipe which replaces the swage drain becomes part of the capital structure, because without that pipe the line would not be a whole pipeline.

The accounting of that cost is handled as a maintenance item. If we were to complete the details of that transaction it would mean that we would wind up with more capital investment on the books than we had originally with the swage drain, but the item is so small from the standpoint of money that the accounting department does not think it advisable to use the necessary routine mechanics in transferring that transaction.

Direct Examination by Mr. Hedrick.

Page 9 is entitled "Pipe Line Department, District No. 4; Additional Capital Expenditures," etc.

The first item, "Replace Drips," is for the replacement of one drip in each of the years 1940 to 1943, inclusive, showing an expenditure of $1,468 for each year.

The next item is one of replacing river headers. In 1940 one 18 inch by 10 inch header will be replaced. In 1942 one 24 by 18 inch header will be replaced. In 1942 one 24 by 12 inch header will be replaced. In 1943 one 18 by 12 inch header will be replaced. In 1944 one 24 by 16 inch three-run header will be replaced; and in 1945 one 16 by 12 inch header will be replaced. In 1946 a 24 by 12 inch header will be replaced.

The third item is "Install Gate Boxes." That work is now in progress.

The next item is to install 6 inch blowoff connections in the years 1940, 1941 and 1942. The amounts shown are for the installation of three 6 inch blowoffs in each of the years.

707 Item 5 is "Install 18 Inch Loop, Weeping Water Creek." Weeping Water Creek is located just southwest of the Missouri River crossing, approximately 15 miles from there. It is crossed at the present time with a single 24 inch pipeline, and for the same reasons which have been explained for the installation of loop lines, we will install an 18 inch loop line at this location in 1942, involving an expenditure of $36,591.

Item 6 is "Raise 3 Inch Blowoffs." 47 three inch blowoffs will be raised in 1940 at a cost of $1,034.

Item 7 is "Install River Clamps, Reinforcing Straps, Republican River," requiring an expenditure in 1939 of $11,658. That work is now in progress.

Item 8 is "Cathodic Protection," requiring an expenditure in 1941 of $3,969 and in 1942 of $3,970. We are going to protect approximately three and eight-tenths miles of 24 inch line in each of those two years.

Item 9 is "Install River Clamps and Reinforcing Straps, Little Blue River," with an expenditure in 1941 of $21,315.

The Little Blue River is crossed with six 12 inch pipelines and is shown on Exhibit 103. It is the first multiple line crossing northeast of the Kansas-Nebraska state line. The reasons for this expenditure are that the river is changing its channel. The river is attempting to return to its former channel, which is north of the present channel. There is also a possibility that a new channel will be formed south of the present channel. These 12 inch lines will be lowered and reconstructed in 1941 for the purpose of reconditioning the lines and lowering them to a depth of six to eight feet below the present stream bed as a protection against washing when these new channels are formed. This work will be done at an expenditure of $21,315.

A reinforcing strap is a metal bar made of mild steel one-half inch thick by two inches by ten inches long. These bars are welded across the girth weld and are spaced 90 degrees apart; that is, there are four reinforcing straps for each girth weld. That is to strengthen the tensile strength of the girth weld. I should explain in connection with this item at the Little Blue River that this expenditure in 1941 is for the additional capital expenditure which will be required; that is, the additional clamps which will be installed and the additional reinforcing straps which will be installed.

The book cost of property retired and salvage are shown at the bottom of the page.

Under "Book Cost of Property Retired," Line 1 is "Retire Drips, 17-18-19-20." Those are the numbers by which the drips are referred to from an operating standpoint and are shown on Exhibit 103 in the horizontal line entitled "Drips."

708 *Cross-Examination by Mr. Slaff Interposed.*

The book cost of No. 17 of the drips appears to be about 35% more than the book cost of Nos. 18, 19 and 20. Drip No. 17 is on the discharge side of Station No. 5, and was not installed by the same contractor that installed the remaining drips. The difference is the difference in contract labor. The additional expenditure for drips Nos. 17, 18, 19 and 20 will be the same. That is an expenditure to be made by our own company personnel and we can control those expenditures. The contract labor, of course, is submitted by the contractor in his proposal for the performance of that kind of work. There is no physical difference in the type of construction or anything of that sort that would explain the difference in price. That does explain the difference in the cost of many items. In this particular case it was the difference in the unit cost the contractors submitted.

Direct Examination by Mr. Hedrick.

It is suggested that there may be some confusion with reference to the names Little Blue River and Big Blue River. The river I am testifying about on page 9 of Exhibit 105 is called Little Blue River and is located in District No. 4 in the southern part of Nebraska, and Item 9 on page 9 crosses that river. I have heretofore testified concerning a Big Blue River, and that river is located in Moore County, Texas, and is crossed by the main trunk gathering line of Texoma Natural Gas Company.

We have heretofore constructed a suspension bridge across the Big Blue River in Moore County, about which I have testified, and I have also testified that we will in the future construct another suspension type bridge across Big Blue River, which is designated on Exhibit 101 as Big Blue Creek, in lieu of the under-river 24 inch line that is there at this time. We also cross with a main trunk gathering line the Big Blue River in Moore County, Texas, at another point, but we do not contemplate any remedial work at that place.

Turning now to page 10 of Exhibit 105, I will explain Items 1 to 21, inclusive, on that page.

The first item is "Replace Drips." We will replace

one drip in each of the three years, 1940, 1941 and 1942, at a cost of $1,468 in each year.

The second item is "Replace River Headers." In 1940 we will replace one 24 by 18 inch header; in 1941, one 18 by 10 inch header; in 1942, one 24 by 18 inch header; in 1943, one 24 by 18 inch header; and in 1944, one 24 by 18 inch header.

The third item is "Replace 24 Inch Line—Walnut Creek." Walnut Creek is a stream crossed with a 24 inch pipeline. It is located three and one-half miles west of the company's Red Oak meter setting. There are two reasons for the work to be done at this creek,
709 one of which is corrosion, and the second being to lower the 24 inch line below the scouring gradient of the creek.

By reference to page 18, Exhibit 105, under District No. 5-W, it will be observed that we have been performing work of this nature since 1935. A large number of these rivers and creeks in Iowa have been straightened. The farmers will form a drainage district and combine their resources and straighten a section of a stream for the purpose of increasing the run-off, reducing flood conditions, and increasing the acreage of their fertile land.

When a meandering stream is straightened, the velocity of the water increases. This increased velocity causes scouring of the stream bed. It is endeavoring to approach a normal gradient of flow. Our experience has been that this scouring has scoured to depths below the depth of the pipeline, which leaves the pipeline exposed to debris and ice jams and the forces of flood waters. We have had to do considerable of this kind of work in Iowa and Illinois, due to the straightening of channels and the scouring of the stream beds.

At Walnut Creek it is our judgment that this crossing should be reconditioned. It is not practical to recondition a 24 inch pipe while in service across a stream. We depend entirely for the stability of the 24 inch line on the back fill and on the soil adjacent to the sides of the pipeline and at the bottom of the pipeline. If soil or back fill are removed from this 24 inch line, it is subject to floating during flood conditions, and at vertical bends there is a resultant component of force, caused by the internal pressure of the line, which has a tendency to lift the pipe at that point.

To do the work desired, we are going to lay a new sec-

tion of 24 inch line approximately 300 feet long. This new line will be laid across the stream at a depth of six to eight feet below the present stream bed. That depth to which I refer will depend entirely upon our survey of the stream at the time or prior to the execution of the work.

After this line has been constructed we will have a shut-out and connect the new line to the existing 24 inch line. The old line that is now across the stream will be removed from service. This work at Walnut Creek will be done in 1940, at an expenditure of $8,833.

The next item is "Replace 24 Inch Line—Middle Nodaway River." The Middle Nodaway River crossing is ten and one-half miles east of the Red Oak meter station, as shown on Exhibit 104. This stream is now crossed with a single 24 inch line. We are going to construct a new 24 inch section of line in 1941 at an expenditure of $8,833, which will be a section 300 feet long. 300 feet is about the minimum we can practically handle when replacing a section of line of this character.

The next item is "Replace 24 Inch Line—South River." South River is three miles east of compressor station No. 8, and in this connection I will refer you to "Replace 24 Inch Line—Box Elder Creek," in Line 20. Box Elder
710 Creek is due west of South River and is a tributary to South River. My explanation of one would apply alike to the other, and the reasons for replacing the 24 inch line at each of these points will be the same as those I have already mentioned.

In 1942 we will replace the single 24 inch line at the South River at a cost of $8,833, and also the 24 inch line at Box Elder Creek.

I stated that the Middle Nodaway River is ten and a half miles east of the Red Oak meter station. I should have said that it is located three miles west of main line gate No. 55, as indicated on Exhibit 104. It is the West Nodaway River which is located ten and a half miles east of our Red Oak meter station.

The reasons for constructing a loop line at the latter location are the same as have been given in connection with other loop lines. We will construct this loop line in 1940 at a cost of $26,362.

The seventh item is a 12 inch loop 1980 feet long. The overflow area is 1815 feet across the South River. We have flood periods of six to eight days at Box Elder Creek.

The latter is a tributary of South River and whatever condition there is on one stream will affect the other.

In 1941 we will construct a 12 inch loop line at South River at a cost of $24,703. Box Elder Creek has an overflow area of 3215 feet.

Item 8 provides for a 12 inch loop across this creek and overflow area a distance of 3415 feet at a cost of $35,523.

Squaw Creek is crossed with a single 24 inch line and is located 8½ miles east of compressor station No. 8, as shown on Exhibit 104. The overflow area at this point is 3500 feet. Item 9 provides for a proposed loop line 3650 feet long to be constructed in 1942 at an expenditure of $37,295.

At Otter Creek, located two miles east of main line gate No. 61, which is now crossed by a single 24 inch line, a loop line will be added in 1942 at a cost of $19,652. This is Item 10.

The overflow area of that creek is 1100 feet. The loop line will be 1310 feet long. With one exception all of these loops in 5-W are 12 inch loops.

Item 11 refers to 115 coupling sleeves. We have a number of locations along the pipeline in western Iowa where the 24 inch line crosses small streams with varying amounts of overflow area. At some of these points we cannot justify loop line construction, but we are going to reinforce the line and provide more stability by installing sleeves around the 24 inch couplings.

The picture in the lower lefthand corner of Exhibit 106 entitled "Split Steel Welding Sleeve Installed on 24 Inch Coupling" shows a steel forging made in two halves. 711 It is swaged out to accommodate and provide clearance for the 24 inch coupling. This coupling is installed at a place where the joints are coupled and not welded. The 24 inch sleeve is welded at each end circumferentially to the 24 inch pipe. There are two longitudinal welds but these cannot be seen in the picture since they are at the 90 degree point from the top center of the pipe. Our first sleeve installation was made in 1932. We started to develop the design for this sleeve at that time. It was designed so that it can be installed on the pipeline under full operating pressure conditions. This enables us to do considerable remedial work on couplings without removing the pipeline from service.

(EXHIBIT 106 was offered and received in evidence without objection.)

These 115 coupling sleeves will be installed in 1939. The

work has been approved by the management and the actual physical work will be done as soon as weather conditions permit.

Item 12 provides for the installation of 6 inch blowoffs. We will install two blowoffs in each of the years 1939 and 1940; three will be installed in each of the years 1941, 1942 and 1943; and in 1944 two blowoffs will be installed.

Item 13 refers to the replacement of 5,000 feet of 24 inch pipe at Keg Creek, which is located just south and west of Glenwood, Iowa.

(A document containing two pictures, one numbered 20-3, entitled "Showing Location of 24 Inch Line Along CB&Q Tracks West of Keg Creek," and the other numbered 20-4, entitled "Keg Creek, Looking Upstream from South Bank. Rock in Stream Shows Location of Pipeline," was produced by counsel, and at the direction of the Examiner it was marked Exhibit 109 for identification.)

At the time the 24 inch main line was constructed east from the Missouri River in western Iowa in 1931, we were not able to secure rights of way for the projection of a straight line over the farm property shown in the top picture of Exhibit 109, No. 20-3. It is that small cleared area just to the left of the righthand edge of the picture approximately 1¼ inches from the bottom of the picture. The land in the lower righthand corner is not the land to which I referred. It is the land as indicated by a horizontal line which is above what seems to be some rough vegetation. It is approximately directly opposite and on a horizontal line from the two flags shown on the picture.

We were fortunate in securing a right of way, however, from the Burlington Railroad, which permitted us to construct the 24 inch line along and on their right of way. The 24 inch line leaves the private right of way at the fence line indicated by the fence posts in the lower righthand corner of the picture. It enters the railroad property at the point indicated by the white flags. It proceeds down the railroad r t of way to the right of the adjacent
712 track to a poi. eyond the semaphore. It continues further along the right of way between the opening in the trees about the middle of the picture from top to bottom. It is to the right of the horizontal center of the picture. Immediately after the pipeline enters that point where the opening in the trees exists, it makes a bend to the right, or south, and crosses Keg Creek. This creek is shown in the picture at the bottom of Exhibit 109. It flows

toward the lower lefthand corner in a general northeasterly to southwesterly direction. A rock will be noted at the point where the 24 inch line crosses this creek. Within two or three hundred feet after crossing this creek the pipeline returns to what was the original projected line.

The owner of the property across which we were at first unable to obtain a right of way has passed away within the last year or two and we have now ascertained that we can purchase a private right of way across this particular section of land. A hazard exists in having a pipeline parallel to and on the railroad right of way. In the event of a railroad wreck at that location, serious damage to the 24 inch line might result. Conversely, if the pipeline should have a failure at any point along the railroad right of way it would imperil the railroad property as well as life.

It will be necessary to recondition the 24 inch line across Keg Creek and for that reason it will be necessary to construct a new section of line. It is our judgment that the 24 inch line should be removed from its present location along the railroad right of way and relaid on a private right of way, with a new crossing at Keg Creek.

It will be noted in the picture in the lower part of the page of Exhibit 109 that the rock protection which we have placed in the stream is an obstruction to the stream flow. It can be observed that the gradient of the stream, both below and above the crossing, is lower than at the crossing. If this rock protection should be washed out by flood the results would be serious to the single 24 inch pipeline. The stream was straightened out about five years ago and scouring has been taking place since that date. We are going to reconstruct this section of 24 inch line, 5,000 feet in length, in 1942, at a cost of $58,696.

The railroad is shown to the left of what appears to be the spoil bank, or what remains of an old levee, on the left side of the bottom picture on Exhibit 109. There is a short overflow area in the immediate vicinity of the Keg Creek crossing. This overflow area is not shown on the picture but would appear at the right if the picture were extended.

(EXHIBIT 109 was offered and received in evidence without objection.)

Cross-Examination Interposed by Mr. Slaff.

The physical conditions under which the 24 inch line is to be replaced at Keg Creek are practically the same as those at Walnut Creek.

You ask why the large difference in the unit price 713 per foot of pipe in the case of the two installations.

The line to be reconstructed at Walnut Creek involves a section 300 feet long. At Keg Creek we are constructing a line 5,000 feet long, approximately a mile. The unit costs of the latter will therefore be less, due to the additional footage involved in the project. The reason for this is that we will have practically the same amount of equipment to reconstruct the Walnut Creek crossing as will be required to construct the new section of line across Keg Creek and to the west. The overhead cost of the moving in and out of equipment, equipment rentals, personnel, overhead, and office rent will all be spread against 5,000 instead of 300 feet. Both items will be built by contract.

The same explanation would apply to the replacement of 300 feet in the Middle Nodaway River and the replacement of 300 feet at the South River. The replacement at Box Elder Creek is also of 300 feet, and the same explanation applies there.

Direct Examination by Mr. Hedrick.

If we were laying 300 feet across Walnut Creek and 300 feet across Keg Creek, the cost of that work would be almost the same. As I recall these two stream crossings, Keg Creek would be more expensive than Walnut because of the depth of the stream, which can be observed from the picture. The laying of the greatest percentage of the 5,000 feet will be west of Keg Creek and will be what we term nominal construction, which also tends to decrease that overall unit cost.

I will now pass to Item 14. The Missouri River is crossed at a point south of Plattsmouth, Nebraska, as shown on Exhibit 103. The channel is crossed with 10 inch pipelines. At the time of construction we considered the Missouri River to be the most treacherous stream with which we had to deal. At that time we did not consider the Canadian River as serious a stream as the Missouri. We have changed our minds since that time. We designed a 10 inch crossing across the Missouri for the reason that

we did consider it a very treacherous stream. We based our judgment on our past experience in constructing pipelines across the Missouri River, as Mr. Floyd C. Brown has testified.

The characteristic of the Missouri River is to shift in its channel course. It is known to shift in its stream bed. There will be much shifting of sand bars. The same factors are working on this crossing which we enumerated for the lines in the Canadian River, namely, fatigue, corrosion, structural weakness, and the natural forces of the stream as a result of floods and ice jams.

We have no way of determining the amount of corrosion that exists on the Missouri River lines. In order to reinforce this crossing and provide the insurance that is required for continuity of service, we are going to construct four new 10 inch lines in the years 1943, 1944, 1945 and 1946, as shown here, at an expenditure of $54,158 in each of the four years. One line will be constructed each year.

We are limited in this construction program on account of weather conditions and the drainage situation at
714 the Missouri River. This is a safety measure and we cannot afford to take any chances on losing this river crossing. The physical work on the Missouri River crossing was started in the fall of 1930 and it was not completed until some time in the summer of 1931. The work was completely shut down during the winter months on account of ice in the river. If we should lose the Missouri River crossing, in my judgment it would take not less than thirty days, and more likely sixty days, to complete a satisfactory crossing for the resumption of service.

The 18 inch loop line, Missouri River to Horse Creek, referred to in Item 15 is to be constructed from the east 18 inch by 24 inch header at the Missouri River on to Horse Creek. Beginning at said Missouri River header, there exists approximately a mile and a half of overflow land. During flood periods water accumulates in this area and the only outlet is by evaporation or seepage.

We have a serious condition at Mays Creek, which is located approximately three-eighths of a mile east of Keg Creek, and also at Horse Creek, about one and one-third miles east of Mays Creek. The 18 inch proposed loop line is to be constructed to provide additional insurance to the 24 inch line across this four mile area. We have spent to date considerable sums of money in maintenance at Mays and Horse Creeks. Within the past three or four

weeks we have had a flood which damaged the protective structure at Mays Creek. There is a direct drop or difference in stream bed elevation immediately below the 24 inch line crossing of approximately fifteen feet. We have a similar condition at Horse Creek. We propose to construct an 18 inch loop line, as explained, in the year 1942, at a cost of $147,995.

The work referred to in Item 16 for the relocation and extension of the 18 inch line at West Nishnabotna River is now in progress. That is also true of the work referred to in Item 17 pertaining to the laying of a 12 inch loop at Grand River.

Item 18 refers to cathodic protection which we propose to install on approximately three miles of the main line in each of the two years 1941 and 1942..

Item 19 provides for the raising of 36 three inch blowoffs in 1940 at a cost of $792.00.

Item 21 covers the installation of 24 inch pipe to replace gates Nos. 49 and 53. This work has been completed.

Page 11 shows the book cost of property retired and salvage with reference to the capital expenditures shown on page 10.

Passing to page 12 of Exhibit 105, Item 1 provides for the replacement of drips. These drips are to be replaced for the reasons already given in connection with other drips. There will be one drip replaced in each of the three years, 1940, 1941 and 1942.

The second item reads "Replace River Headers."
715 One header will be replaced in 1940 at an expense of $1,696, and one in 1941 at a cost of $1,709. Other headers will be replaced through the years 1942 to 1945, inclusive; one in 1942 at a cost of $2,805, one in 1943 at a cost of $1,709, one in 1944 at a cost of $1,696, and another in 1945 at a cost of $1,696.

Item 3 provides for the installing of six inch blowoffs, beginning in 1939 and ending in 1944, at a cost of $346. Two of these blowoffs will be installed in 1939, three in each of the succeeding four years, respectively, and one in 1944.

Item 4 provides for replacing the 24 inch line at Bridge Creek. Bridge Creek is crossed with a single line. The crossing is about one mile north of Sigourney, Iowa. The reasons for replacing this 24 inch line at Bridge Creek are the same as have been given for the replacing of other similar crossings, such as those at Walnut Creek, Middle

Nodaway River, South River and Box Elder Creek. This work will be done in 1941.

Item 5 refers to the construction of a 12 inch loop line at English Creek. This work will be done for the same reasons that have been given for the construction of a loop line on Box Elder Creek. English Creek is now crossed with a single 24 inch line one-half mile east of main line gate No. 63 on Exhibit 104. The loop line will be installed in 1941.

Item 6 has to do with the installing of 161 coupling sleeves. These coupling sleeves will be installed for the reasons stated in explaining other coupling sleeve installations. The expenditure has been approved and the work will be done as soon as weather conditions permit.

Item 7 provides for the purchase of land in fee in connection with coal mining operations. At the time the rights of way were purchased for the construction of this 24 inch pipeline, it was necessary to include in some of the grants a special provision relative to the pipeline company's obligation to purchase land if and when coal is mined on the respective properties. In 1937 we were required to purchase in fee some land along the pipeline in order to prevent coal mining operations near by and under the pipeline. This is strip mining ordinarily, although there is some shaft mining involved. In the year last mentioned we purchased a strip of land containing 20 acres across the Northeast ¼ of Section 20, Township 75 North, Range 18 West, Marion County, Iowa.

The right of way grants under which these fee purchases must be made to protect against coal operations either specifically state the price that we will be required to pay or state that we will be required to pay the price that a coal operator would pay for the purchase of that particular land. In the 1937 purchase we made at the rate of $300 an acre, or a total of $6,000.

We have reviewed the right of way grants and have
716 found three grants which contain specific provisions requiring the company to purchase the land as a protection from coal mining operations. In these grants the number of acres is specifically set forth. We are required to buy only as mining operations approach.

There is a strip mine now in the Northeast ¼ of Section 20, Township 75 North, Range 18 West, Marion County, Iowa, and shaft mine operations in the Northwest ¼ of that same section. There are also coal mining operations

in the Northwest ¼ of Section 21 and the North ½ of Section 22, same Township and Range. The strip mining operations are already in reasonably close proximity to the pipeline. In Sections 21 and 22 the mining operations are practically adjacent to the pipeline at one point and approximately an eighth of a mile from the pipeline at another point. The shaft mining operations are now in progress in the Northeast ¼ of Section 20. There is a shaft on the south side of the pipeline and an air shaft on the north side of the pipeline. The program of this coal operator calls for the connection of these two shafts, which will place shafting or tunneling directly below the pipeline.

This grant provides that we are to purchase all of the land north of the pipeline in the North ½ of the Northeast ¼ and a strip ten rods wide south of and parallel to the pipeline at the price which a bona fide purchaser would pay for coal mining purposes. We have determined that price to be approximately $300 an acre.

We have a right of way grant in Section 19, same Township and Range, which would require us to purchase the land at $300 an acre, to the total amount of $36,000. In our grant in the Northwest ¼ of the Northwest ¼ of Section 21, same Township and Range, the purchase price of the land is fixed at $4,650. These three amounts total approximately $50,000. We have provided an amount of $5,000 for each of the ten years from 1939 to 1948, inclusive, for the purchase of this coal land. It is our judgment that some time during that ten year period we will be required to spend that sum of money for the protection of the pipeline from coal mining operations. It may be spent in two years, or it may cover a three or five year period.

Questions by the Examiner.

The 1937 purchase covered one tract consisting of 20 acres, at $300 an acre, which with these other three tracts would make four tracts in all.

Direct Examination by Mr. Hedrick.

(August 2, 1939)

We will proceed now to Item 8, which provides for the replacing of three 12 inch lines across the Mississippi River in the years 1944, 1945 and 1946. The Mississippi River

crossing is located south of Muscatine, Iowa, and con-
717 sists of six 12 inch lines. The overflow areas on each side of the river are crossed with two 18 inch parallel lines. This crossing was constructed in 1931, and the time of construction was approximately two and a half months. Those lines were constructed by a separate contractor from those constructing the main line. We had a contractor who was experienced in handling submarine and subsurface construction to construct this particular crossing. These lines across the Mississippi are laid at depths below the river bed varying from zero to four feet. We were required by the War Department to place the line nine feet from the mean low water elevation to the top of the pipe across what the War Department describes as the main channel. We have a warning sign to navigation installed on the west levee of this river, right opposite the pipeline crossing. This sign is large enough to be read from any vessel in the navigable channel. This is to prevent the dragging of anchors in that particular area, which might damage the pipeline.

The reasons for installing three new lines across the Mississippi are identical with those which have been given for installing new lines across the Missouri and Canadian Rivers, namely, to guard against loss by corrosion, fatigue, structural weakness, and direct action by the force of the stream or changing river bed.

As we approach the larger markets the necessity for continuity of service increases. In other words, if we had a break causing an interruption of no more than a day or so on the south end of the line, we might have enough gas packed into the line so that Chicago would not be entirely without gas. If, however, the break occurred near Chicago, the period through which gas would be available to Chicago would be very much shorter. In order to reinforce the Mississippi River crossing, in our judgment it is absolutely necessary to construct three new 12 inch lines across the river, one in each of the three years already stated.

Cross-Examination Interposed by Mr. Slaff.

We have spread out all of the work which we have proposed to do for the reason that there are limited times during the year that such work can be done. We are limited by weather conditions, by time and load conditions.

These are the three main factors that limit us. We can't build a crossing at the Mississippi River when the river is frozen over. It is not practical to do so in the light of the requirements of the War Department. The period during which we can do this character of work with economy starts the latter part of April and ends in September. About September our domestic and heating load comes on. Thus we have four or five months within which to do this character of work.

Then we have considerable work going on over the entire pipeline each year in addition to these particular items. Our organization must inspect and supervise all that work. If we had only one project like the Mississippi River crossing, we could handle it ourselves satisfactorily. This work would be contracted.

718 *Direct Examination by Mr. Hedrick.*

Nevertheless we must have proper supervision and inspection of the work that is going on. We inspect all construction work let to contractors.

Item 9, captioned "Cathodic Protection," calls for an expenditure in 1941 and 1942 for protecting approximately 3.2 miles of pipeline in each of those two years.

Item 10 provides for raising 60 three inch blowoffs in 1940. These blowoffs will be raised for the same reasons we have given for the raising of other blowoffs.

On page 12 is shown the book cost of property retired and the salvage as related to the additional capital expenditures shown.

You ask what is the matter with the weather at this time that prevents our installing the coupling sleeves referred to at page 10, Item 11. In order to install coupling sleeves and recoat the pipeline with a paint protective coating, it is absolutely necessary to have the pipe thoroughly dry in order to apply the coating efficiently. The moisture accumulates on the outside surface of the pipe on account of the difference in temperature between the pipe and the atmosphere. This occurs for the same reason that moisture gathers on the outside of that water pitcher there. It is condensation. Condensation is more severe when the humidity of the weather is high. We have attempted to devise means to dry off water from the outside of the pipe in order to apply the protective coating. The efforts

have been unsuccessful, and we have to wait on a proper relation between humidity and temperature of the air and pipe before this work can be done. That will occur in the cooler months of the year, beginning about September.

Questions by the Examiner.

You ask why on page 12, in connection with the 24 inch line over Bridge Creek, the ratio is about seven to one between the capital expenditure and the book cost of property retired, whereas in the case of the Mississippi River crossing the ratio is two to one. Bridge Creek shows a capital expenditure in 1941 of $8,833 and a retirement of $1,499. When Bridge Creek was originally constructed in 1931 the contractor submitted unit costs for the construction of an entire section of the pipeline. When he bid on the particular section of the pipeline which he constructed, he did not bid a specific item for this crossing, like he would at a multiple river crossing, for example. The unit costs that applied to the construction of this crossing were the same that applied to any normal crossing.

It is more expensive to construct a pipeline across a stream than on dry land, and that expense we are now discussing is averaged out in his entire unit price. Now, we have to construct this line at one specific location, and it will cost considerably more than if we were constructing a normal pipeline across level country. The added expense is due to the cost of moving in and out equip-
719 ment and is in effect an overhead cost. The added cost in there at the present time is also due in part to increased taxes, shorter working hours and higher wages. All those items affect the cost of doing work as of June 1, 1939, as compared with doing it in 1930 and 1931.

You ask as to the type of equipment ordinarily used in constructing such a crossing. It takes dragline equipment; and in the majority of this work in Iowa, which is detailed on page 18 of Exhibit 105, we have had to use steel sheet piling in the excavation of a trench to get the line deep enough below the future gradient of the stream.

The retirement of $1,499 represents the average cost, that is, what it actually cost us, in money paid to the contractor plus the cost of material that actually went in there, at the time of the original construction. At the time the line was constructed across Bridge Creek the

contractor submitted a bid which was accepted for the construction of 100 miles or more of pipeline, which included some of the streams that necessarily would have to be crossed. He submitted unit prices per foot for that work and did not submit special bids for any of the stream work.

In the case of the Mississippi River crossing he submitted a bid only for a river crossing and that contemplated river work only, the unit costs for which are considerably higher than the unit costs for construction of a hundred miles of pipeline. I can illustrate that by referring to the manufacturing of automobiles. If a machine shop be designed to construct a single automobile, the expense would be many times more than the expense of manufacturing automobiles in a plant such as that of Buick or Ford.

Direct Examination by Mr. Hedrick.

Turning to page 13, we find the first item is captioned "Replace Drips." The necessity for this replacement has already been explained. One drip will be replaced in each of the years 1940 to 1944, inclusive.

The second item is entitled "Replace River Headers." The necessity for the replacement of river headers has been explained. In 1940 we will replace one 18 by 12 inch header; in 1941 one 24 by 18 inch header; in 1942 one 24 by 12 inch header; in 1943 one 24 by 18 inch header; in 1944 one 18 by 12 inch header; in 1945 one 24 by 18 inch header; and in 1946 one 24 by 18 inch header.

The third item provides for the installation of 14 six inch blowoffs. The necessity for those has been explained. Two will be installed in 1939, two in 1940, two in 1941, three in 1942, two in 1943, two in 1944, and one in 1945.

Item 4 involves an expenditure at Brush Creek. That creek is now crossed with a single 24 inch pipeline at a point two-thirds of a mile east of main line gate No. 76, north of Depue, Illinois, as shown on Exhibit 104. The installing of a 12 inch loop line at this crossing is necessary for the reasons already stated with reference to the installing of similar loops which I have already discussed. The only difference is that this crossing is near the Chicago market, which, as I have explained, makes it even more necessary as insurance of continuity

720

of service. The overflow area is 350 feet, and the loop line will be 1000 feet long. The difference is due to the fact that in order to secure an adequate location for the gate valves and for proper blocking, it is necessary to install those valves on the hills on each side of this overflow area. We try to place the headers outside of the overflow area and on ground where the conditions are entirely stable.

Item 5 provides for the installation of 31 coupling sleeves in 1939. This work is approved and will proceed as soon as weather conditions permit.

Item 6 provides for installing 42 coupling sleeves in 1940. I have explained the necessity for installing coupling sleeves in connection with my testimony concerning the installation of similar coupling sleeves in Districts 5-W and 5-E.

Item 7 provides for the replacing of 24 inch line at Devils Slough. This slough is crossed with a single 24 inch line and is located less than a mile west of the I. & M. canal in Illinois. We are particularly concerned with erosion in this area. At the present time we have a program for replacing 165 feet of 24 inch pipe, the work to be done on Labor Day. We have chosen this day because load conditions are low. Another reason is that we have a delivery to the New Jersey Zinc Company at Depue, Illinois. They are unable to take and accept a reduction of gas flow until that date. In fact, they have required this advance notification. This is due to the time involved in the shutout in connection with this work. We notified the customers that we proposed to do this work, and the New Jersey Zinc Company advised us that they could not accept reduced deliveries until Labor Day.

The pipe to which I referred is located between Devils Slough and the I. & M. canal. Soil conditions in that area are of a peat bog nature. There is considerable moisture in that section of the country, which aggravates the corrosion conditions. This is similar soil to that where the pipeline break occurred last year near Sheffield, Illinois, to which Mr. Floyd C. Brown testified. For these reasons we are going to replace the 24 inch line across this slough and at the same time lay this line at a depth of six to eight feet below the present elevation of the stream. About 300 feet of pipe will be involved in this replacement.

Item 8 refers to the replacement of three 12 inch lines

across Fox River. That river is now crossed with six twelve inch lines located just northeast of Ottowa, Illinois, as appears on Exhibit 104. The overflow area on the west side of Fox River is crossed with two 18 inch pipelines. Fox River is a navigable stream, and the crossing of this stream was done in accordance with the specifications and requirements of the U. S. War Department.

721 Those War Department requirements provided that the top of the pipe should be two feet below the elevation of the stream bed. The stream bed in Fox River is solid rock. In order to construct this crossing the contractor was required to excavate a trench in solid rock for each of these six 12 inch lines by dynamiting under water. Due to the roughness of each trench in which the 12 inch lines are laid, this rock causes penetration of the protective coating on the pipe, which is breaking down. The result is corrosion.

I might add that the covering above the pipe in the trench is also rock, which is the only material available at that place. We are going to replace three of the 12 inch lines across this river, one each in the years 1943, 1944 and 1945. In fact, we are going to install three new lines across the river as a safety measure. We are unable to determine specifically everything that is taking place in each of those river lines. In such a situation we cannot take a chance of interruption of service at any time for any reason. This work is to be done as a result of our best judgment in the proper and efficient operation of this pipeline system. That is also one of the reasons for the replacement of the lines across the Mississippi and Missouri Rivers.

Cross-Examination Interposed by Mr. Slaff.

Yes, these lines will be replaced at the same location which they now occupy. It will be more economical in this particular instance to remove the present lines from these rock excavated trenches than it would be to have to excavate additional trenches. We will not have to blast new trenches across the river. Naturally, there would be some danger in blasting close to the pipeline.

Direct Examination by Mr. Hedrick.

Item 9 presents another instance of cathodic protection, the need of which has been explained heretofore. In each of the years 1941 and 1942 cathodic protection is to be installed for approximately four miles of 24 inch line.

Item 10 provides for the raising of three inch blowoffs, to be done in 1940. The necessity for this work has been explained. 46 blowoffs are involved in this item.

Item 11 provides for the replacement of 24 inch line across Brush Creek. This is the same creek as referred to in Item 4 on page 13. The reasons and the necessit for the replacement of 24 inch line across this creek are identical with those given in support of the replacement of similar line crossings, with the exception that again we are approaching closer to the main delivery points of the system. This work is to be done in 1941 at a cost of $8,833 for a section of 300 feet of 24 inch line. This line is in addition to the loop line that will be installed under Item 4. When we get through with this replacement we will have two lines across Brush Creek.

722 *Questions by the Examiner.*

You ask if we would not be in the same fix if we had an interruption any where along the line between Chicago and Texas as if it were near Chicago. That is true, except that if we assume an interruption in the vicinity of Beaver Creek, Oklahoma, we would have available all the line pack which is in the line from Beaver Creek to Chicago. If we have an interruption at Fox River, which is within 30 or 40 miles of Chicago, obviously our line pack would be very, very small from which we could draw in supplying the market. Also we have other loads along the pipeline for which we are committed for delivery.

Direct Examination by Mr. Hedrick.

We can no more cut off the firm load for Davenport, Iowa, for instance, than we can for Chicago. We can cut off all the industrial loads. The load along the pipeline, not counting Chicago, including industrial sales, amounts to approximately 30 million per day, as against a delivery of 185 to 190 million cubic feet to Chicago. What I am

trying to say is that in case of an interruption that has a short duration, we can stand an interruption on the south part of the line better than we can on the north. If we had a major interruption lasting a period of several days, regardless of whether it was near Chicago or in Oklahoma, the results as far as Chicago and the eastern points of delivery are concerned would be the same.

It is these major interruptions we have in mind in taking these precautions. A major interruption might be repaired in 24 hours or it might require three or four days for repair, depending entirely upon its nature and location, the condition of the soil, and the weather conditions prevailing at the time.

I can give you an illustration of what I am trying to say. In the testimony of Mr. Floyd C. Brown he referred to what we know as the Sheffield break. This break occurred at a point approximately three miles northwest of Sheffield, Illinois, about 7 A. M. on Sunday, February 13, 1938. The failure resulted because the ground was frozen and then thawed out by a warm period which took the frost out of the ground. During this period of warming up we had continuous rains, which created a very unstable soil condition at the point of failure. The exact location of the failure was on an old lake bed and the soil was of a peat bog nature. The result was that the moisture got under the pipe, resulting in buoying or floating it out of the ground, causing an angular deflection at the coupling at that location. The pressure of the gas within the pipe was then sufficient to cause a vertical component of force and a complete failure of the line.

The failure was observed immediately at the discharge gauge at Station 10, just west of the break. A report of the failure was immediately made to the dispatching office in Chicago. The dispatcher got in touch with Mr. Kesinger, Mr. Davidson, Mr. Bulla and myself—in fact, all men in the organization who are responsible for continuity of service. At that time each customer was
723 notified that a disruption existed in the pipeline; and immediate steps were taken to remove the interruptible loads and also to protect all domestic firm sales. Customers like the Peoples Gas Light & Coke Company immediately put their standby equipment in operation.

The next step in a situation of that kind is to notify

the field organization responsible for that part of the pipeline. They in turn notify all subordinate organizations down to the maintenance men. All the emergency repair equipment is immediately placed on trucks and cars and started for the location of the break. We also arranged for the use of tractors, horses and wagons, trucks, pumps, and all other equipment which we thought might be needed in making the repair. That included welding machines.

This particular repair was located approximately three miles from a concrete highway. As a result of the continuous rains the roads were very muddy and rutty. We were required to move all this equipment from this concrete highway to the location of the break over these muddy roads. After we delivered our material to the road, that is, the dirt road immediately west of the location of the break, we were required to move that equipment in to the location of the break across a peat bog soil condition. Meantime the break had to be isolated immediately by closing the main line gates on either end of the break.

In moving the equipment over these muddy roads, I personally went in over my knees in this peat bog soil, so it is apparent what would happen in the necessary hauling of heavy equipment across that same area.

We started to build a wood or corduroy road through this bog by hauling in railroad ties obtained from the Rock Island Railroad in Sheffield and the towns and areas adjacent to Sheffield. In fact, we did haul in from 800 to 1000 ties.

Exhibit 85, introduced in connection with the testimony of Mr. Floyd C. Brown, contains a number of pictures of the Sheffield break. The location of the break is shown in the top picture, or picture No. 1, just west of the trees which are in about the center of the picture. Picture No. 4 will give you a better idea of the water condition existing at the exact location of the break. The rupture of the pipe was practically in the exact center of this water. The parted pipe will be observed in Picture No. 3, which shows the pipe after it was pulled out of the 24 inch coupling.

Referring back to picture No. 1, the water in the ruts reflects the elevation of the water table. Picture No. 2 shows the nose of a large tractor partially submerged

in the unstable soil. You will note the entire radiator is practically covered. Picture No. 3 shows the construction of this corduroy road, using railroad ties. A tractor is used in placing those ties.

Within two or three hours men and equipment started to arrive at the point on the road near the location of
724 this break, and we at once took means to transport the equipment across this unstable soil condition to the location of the break, which is shown in picture No. 4 and also in pictures Nos. 5 and 6. We were able to get a few small pumps to the location of the break by Sunday afternoon and place these pumps in operation. They were not sufficient to handle the large volume of water, however. We at that time made arrangements for securing or bringing additional larger pumps to this location. We immediately took steps to secure two cars of cement. This we could not obtain closer than LaSalle, Illinois, which is east of Sheffield. We made arrangements with a local lumber and supply dealer at Sheffield to have this cement hauled from the plant at LaSalle to the location of the break. This had to be done on Sunday. In fact, there was a time when the cement company refused to permit cement to be hauled from their plant by trucks. They advised that it would have to be handled by railroad. We were able to persuade them of the emergency existing and they did permit the hauling of this cement by trucks on Sunday night. The cement was needed for constructing cofferdams or dams to confine the water so that we could pump it out.

We were aided considerably by the freezing temperature of the night following the break. This permitted a more ready movement of the equipment into the location. On Monday morning we had sufficient material on hand to proceed with the dewatering of this excavation which was blown out by the gas escaping from both ends of the pipe, forming the lake shown in picture No. 4.

The break was finally repaired on Monday evening about 11 P. M. We took immediate steps then to weight the pipeline across these peat bog areas. The emergency protection was gravel filled sacks. We installed final or permanent protection by the use of concrete anchors and by installing steel welding sleeves on each coupling.

That break influenced the policy of the company in pur-

chasing additional tractors, pumps and trucks for such occurrences as might happen in the future. Before leaving this, I would like to mention that we employed over 300 men to assist with the repair of this particular break.

Cross-Examination Interposed by Mr. Slaff.

Yes, our firm supply to Chicago was interrupted. We had partial interruption from Sunday morning about seven A. M. until the completion of the repair, which was about 11 P. M. Monday, February 14. I am referring to the domestic load. Mr. Floyd C. Brown stated in his testimony that the cost of this interruption by loss of gas and including the cost of repair was some $248,875. The cost of the physical repair was slightly in excess of $42,000.

Direct Examination by Mr. Hedrick.

Item 12 provides for installing six 12 inch automatic valves at Fox River. As pipeline operators, we have realized for a number of years the necessity for providing some means or device for shutting off gas when a pipeline break occurs, thereby retaining the maximum amount of gas in the pipeline after the break and preventing the flow of that gas to the atmosphere. In 1934 we made our initial tests and did our initial experimental work and made our initial contacts with the various valve manufacturing companies for the design and manufacture of automatic valve equipment. By automatic I mean that the valve will close completely without the aid of manual operation. Although they encountered several difficulties in the design, such a valve was finally successfully designed and manufactured, beginning about March or April, 1939. We made a number of tests, simulating as near as possible actual main line breaks and resulting loss of gas. As a result of these tests, we were satisfied that the valve with the automatic feature would perform the duty desired. We have formulated a program for the installation of automatic valve equipment. The first equipment of this nature is scheduled to be added this year by the installation of six of these valves at the east side of the Fox River crossing. The

management has given approval to this installation and the valves have been ordered.

Item 13 provides for the installation of two 18 inch automatic valves at the I. & M. canal. This canal is in the central part of Illinois, as appears on Exhibit 104. The expenditure is to be made in 1940.

Item 14 is for the installation of two 18 inch automatic valves at Mud Creek, just west of the I. & M. Canal. This work will also be done in 1940.

Item 15 provides for the installing of two 18 inch valves at Mill Creek, 21 miles west of Mud Creek, in the year 1940.

Item 16 provides for the installation of two 18 inch automatic valves at the east 18 by 24 inch header of the Mississippi River crossing, in the year 1940.

Item 17 is for the replacement of main line gate No. 76, as shown on Exhibit 104, with 24 inch automatic valve equipment. It is in the vicinity of Depue and Princeton, Illinois.

This work is scheduled to be begun in District 6 only at this time. This is in accordance with our policy of protecting the east end of the pipeline system, due to the lack of line pack as we approach Chicago. As already stated, it is the policy of the company to protect the line at the north end more than at the south end.

Question by the Examiner.

You ask what is the actuating principle of these automatic valves. This valve is actuated by a piston. It is what we term the plug type valve, manufactured by the Merco Nordstrom Company. We have directly installed on this valve a cylinder and piston. The valve is operated by means of this piston, through a rack and segment gear.

The gear is directly connected to the stem of the valve.

726 There is an auxiliary tank installed close to the valve installation which is connected to the main pipeline. The pressure which exists in the pipeline also exists in the tank. The tank contains gas.

There is a 1/32 inch orifice between the tank and the 24 inch line. This orifice permits fluctuation of pressure in the tank as the pressure fluctuates in the main line, which may be 10 to 15 pounds in a 24 hour period.

There is another connection made from this tank to the piston actuated valve. In case of break, the pressure on the pipeline decreases suddenly and the pressure on one

side of the piston likewise decreases. The force of the pressure in the reservoir will be exerted against the opposite side of the piston. The gas cannot flow back into the pipeline due to this orifice restriction. The major flow is into this piston actuated valve. The principle in general is identical with the air brake installation on a railroad train. Contrary to general belief, when the engineer makes a service application in his locomotive he does not increase the air pressure on the train system. He releases or decreases the air pressure. That sets in motion what is known as a triple valve, which in turn admits pressure contained in an auxiliary reservoir installed under each car. The force of that pressure actuates the piston under that car, which controls the entire braking mechanism.

Direct Examination by Mr. Hedrick.

The book cost of property retired and the salvage as related to the additional capital expenditures are shown at the bottom of page 13.

Cross-Examination Interposed by Mr. Slaff.

The construction of the pipeline in District 6 was handled by one contractor, unless the Mississippi River crossing be regarded as in District 6. That crossing was handled by another contractor. The explanation for the difference in book cost of drips shown on line 1 and in book cost of property retired is that those two drips which will be retired in 1943 and 1944 respectively were installed by the company and not by the contractor.

Direct Examination by Mr. Hedrick.

Turning now to page 14, the first item is "Replace 8 inch River Lines, Davenport, Mississippi River." This river crossing is a part of the branch line which connects the 24 inch main line with our meter setting at Linwood, Iowa, for the delivery of gas to Davenport, Iowa. Two 8 inch lines are now installed across this river.

The channel of the Mississippi at this point is divided by an island. The flow of the river is generally east to west at this point. The main channel is at the north side of the island. An 8 inch line is to be constructed across

this river in 1945 for practically the same reasons that have been given for constructing three new lines across
727 the main line Mississippi River crossing. The two original 8 inch lines were constructed in accordance with the U. S. War Department's specifications. The new 8 inch line in the main channel will be laid in rock. We propose to reclaim the old line when the new line is laid. We will still have two 8 inch lines across the river.

Item 2, "Raise Three Inch Blowoffs," relates to work to be done in 1940 for installations of four 3 inch blowoffs. The necessity for this work has been explained. The book cost of property retired and salvage as related to those two items are shown at the bottom of the page.

We pass now to page 15, which is entitled "Pipeline Department, Joliet Meter and Regulator Stations, Additional Capital Expenditures".

Item 1 refers to the replacement of vacuum pumps. A vacuum pump is a small piece of equipment directly connected to an electric motor. The pump is used for removing gas or air from the specific gravity balances. The specific gravity balances are used for determining the specific gravity of the natural gas.

With the exception of Item 7, "Replace Water Softener System," considering Items 1 to 13, inclusive, that equipment and apparatus was all purchased in 1931 at the time the pipeline system was placed in operation. The equipment is used either for determining the measurement of the gas or correcting for the measurement of the gas. It is our judgment that this equipment will become worn out and deteriorated to the point where it is no longer serviceable and will be replaced in the respective years as set forth in the exhibit. Item 7, the water softener, was purchased about three years ago and will be replaced in 1946.

Item 14 provides for the construction of a porch at the Joliet regulator station. This work has been approved and is now in progress.

The book cost of property retired and the salvage in connection with the expenditures on this page are shown at the bottom of the page.

Page 16 deals with additional tools for the use of the pipeline department. Use will result in the deterioration of this equipment and will wear it out to the point that it is no longer serviceable or safe to use. This, of course, will necessitate their replacement. That applies to the melting kettles in 1942.

The district numbers shown on this page are the same as those shown on Exhibits 103 and 104. The melting kettles will be replaced in 1947 and 1948 for the reasons given. In 1940 the Sterling pumps are to be replaced on account of the worn out equipment. In 1945 a diaphragm pump is to be replaced. In 1946 the Sterling pumps purchased in 1938 will be replaced. In 1948 the Sterling pumps purchased in 1940 will be replaced.

In District 3 an electric welding machine has been
728 purchased in 1939. In 1942 another will be purchased to replace one purchased in 1936. In 1943 another will be purchased to replace one installed in 1937. In 1944 another welding machine will be added to the present equipment. In 1945 another will be purchased to replace the one purchased this year. In 1947 an additional welding machine will be purchased. In 1948 another will be purchased to replace the one to be purchased in 1942. In 1949 another will be purchased to replace that to be purchased in 1943. In 1950 and 1951, respectively, machines will be purchased to replace those to be purchased in 1944 and 1945.

In District 4 a welding machine will be purchased in 1943 to replace one purchased in 1937. A welding machine will be added to the equipment in 1947. In 1949 one will be purchased to replace the one purchased in 1943.

In District 5 a welding machine will be added in 1942, and in this district two machines will be purchased in 1943 to replace those purchased in 1937. In 1947 two welding machines will be added to equipment, and in 1948 and 1949, respectively, welding machines will be purchased to replace those to be purchased in 1942 and 1943.

In District 6 a welding machine will be purchased in 1942 to replace that purchased in 1936. This is a smaller machine, which accounts for the difference in cost. In 1943 another welding machine will be purchased to replace that purchased in 1937; and in each of the years 1944 and 1947 a welding machine will be added to equipment. In 1948, 1949 and 1950 welding machines will be purchased to replace those to be purchased in 1942, 1943 and 1944.

The adding of new welding machines to the present equipment will be necessary on account of additional maintenance which the pipeline will require in future years, as I have heretofore testified.

Items 4 and 5 provide for the replacement of Rex gas

engine driven centrifugal pumps. The present pumps were purchased in 1938 and will be replaced in 1946.

Item 6 deals with rotary scrapers which will be purchased in 1946 to replace those purchased in 1938.

Item 7 provides for electric lighting units to be purchased in 1948 to replace those purchased in 1938.

Item 8 provides for air compressors to be purchased for District 3, one to be added in 1944, one to be added in 1945, one to be purchased in 1946 to replace the one purchased in 1938, and one to be purchased in 1952 to replace the one purchased in 1944. The reason for the difference in cost of the last item is that the compressor to be replaced in 1946 was equipped with a number of auxiliary tools.

In District 4 the air compressor purchased in 1935 will be replaced in 1943; and in 1951 we will replace the compressor, less the tools, to be purchased in 1943.

729 In District 5 we will add two air compressors in 1943. In 1946 and 1951 air compressors will be purchased to replace those purchased in 1938 and to be purchased in 1943.

In District 6 an air compressor will be added in 1943, one will be purchased in 1944 to replace one purchased in 1936, and compressors will be purchased in 1951 and 1952, respectively, to replace one purchased in 1943 and one purchased in 1944, less the tools.

Item 9 deals with a one-half yard power shovel with drag line and pull shovel equipment. This is new equipment, the necessity for which was explained in the testimony under Texoma Natural Gas Company system, referring to heavy excavating equipment for repairs which will have to be made to the pipeline in subsequent years. I refer to Item 9 on page 6 of Exhibit 105. Full shovel equipment will be purchased in 1947 for each of Districts 4, 5 and 6 in addition to the purchase of such equipment in 1943 for District No. 5.

Item 10 provides for snow plow equipment for trucks and caterpillars to be purchased for the clearing and removing of snow from highways and roads to permit emergency repairs and also to provide the opening of the roads for maintenance work necessary to be carried on. I might state that in the early winter of 1936 we utilized snow shoes and skis in Iowa for covering the pipeline and performing such work as could be done under snow and snowbound conditions in the field.

Item 11 deals with Gould diaphragm pumps. The pumps

to be purchased in 1944 are to replace those purchased in 1934. Those to be purchased in 1948 will replace pumps purchased in 1938.

Item 12 deals with a bench drill, which has been approved by the management for purchase. Likewise, Item 13, a pipe cutting machine, has been approved for purchase by the management.

Item 14 shows small miscellaneous tools to be purchased. These are small tools costing in excess of $25.00, to which reference has not been made in the above mentioned items. Our judgment is that these tools will have to be replaced and additional tools will have to be purchased in order properly to maintain and equip our respective gangs in the carrying on of their duties in connection with the operation and maintenance of this pipeline system.

The book cost of property retired and salvage relating to expenditures shown on page 13 are shown on page 17.

Questions by the Examiner.

You ask how this compares with the tool account on page 7. The latter is a summary. You will note that on page 7 for the year 1939 we show expenditures for tools of $3,581. If you will refer to page 16, you will find the total of tools purchased in 1939 in the same sum. In other words, Item 14 on page 16 is for miscellaneous small tools, and Item 8 on page 7 is the total for all tools, including small tools.

730 You ask why I have a diaphragm pump under centrifugal pump instead of down with the others. That pump came under the classification of small pumps. It was just placed in that classification for no specific reason that I can give. This diaphragm pump is a small pump. The Gould diaphragm pumps are hand operated pumps, as shown in Item 11. The C. H. & E. diaphragm pump is a gas engine driven or power driven pump.

Direct Examination by Mr. Hedrick.

It is my considered judgment, based on my experience and upon my knowledge of the pipeline, machinery, equipment and other property of defendants, of the demands upon the same in the course of defendants' operations, and of the physical condition of this property and equipment, that at the prevailing costs of labor and material as of June 1, 1939, the amounts set forth in Exhibit 105 will be

expended by defendants for additional capital equipment on or before the respective dates set forth in the exhibit.

(EXHIBIT 105 was offered and received in evidence over the objection of counsel for each of the two Commissions, to whom an exception was allowed.)

Passing now to Exhibit 93, Item 2 on page 2 provides for an expenditure in 1939 of $4,101 to construct one four room cottage for the pipeline department. That is a house for the proration clerk located at Fritch, Texas. As the number of wells increases we need additional clerical assistance in handling the proration of the wells over the entire gathering system.

Item 4 provides for a similar house in 1940 at the same cost, $4,101, this house to be for a gas engineer employed to determine rock pressure, open flow and back pressure in connection with the operation of the wells over the entire gathering system.

Item 6 provides for the construction of a four room cottage in 1941 at a cost of $3,815. That house is for a pipeline maintenance foreman to be added to the organization in that year. These foremen have immediate charge of the maintenance gangs and handle all maintenance work throughout the gathering system in connection with lateral lines and booster stations.

Item 7 provides for the construction of four 4-room cottages in 1942 at an expenditure of $15,260. One of these houses will be for a welder who will be required on account of the increased welding work for the pipeline and for the compressor stations. One will be to house an automobile mechanic, who will be required for the added automotive equipment. The third house is for an assistant meter superintendent. The work of this division of the department will increase as the number of wells increase along the gathering system. The fourth is for a gas engineer.

Item 8 provides for the construction of two 4-room cottages at an expenditure in 1944 of $7,630. One of these
731 is for an assistant pipeline superintendent who will be needed in connection with the added work and responsibilities due to the added investment to be made in the gathering system in connection with additional wells, lateral line construction and booster station operation. The other will be occupied by a chart changer, who will be added to the organization in 1944. Chart changers are

used for replacing the orifice meter gauge charts and to assist in the servicing of booster stations.

Item 9 provides for the construction of two 4-room cottages for the pipeline department in 1947 at a cost of $7,630. These houses are for a maintenance foreman and a truck driver, who will be added to the organization in that year to meet the requirements of the system.

Item 10 provides for the construction of one four-room cottage in 1949 at a cost of $3,815. This house will be occupied by an additional chart changer who will be required at that time.

Item 1 on page 6 of Exhibit 97 provides for the construction of eight 4-room cottages in 1939, at a cost of $33,576. We are endeavoring to locate the pipeline organization closer to the actual operations because they are needed there for emergencies. The houses also provide for the welfare of the personnel. We are particularly interested in the welfare of each employee from the standpoint of continuity of service and their value to the organization.

In 1940 the pipeline department will require a house at Station 3 for a pipeline welder. In the same year a house will be constructed for an additional pipeline welder at Station 4. During the same year at Station 2 the bunk house will be converted into a dwelling for a line welder; and at Station 5 a house will be constructed for a pipeline welder. In 1941 a house will be constructed for an additional pipeline foreman at Station 5, and during the same year a house will be constructed for a pipeline superintendent and one for a pipeline welder at Station 6. During the same year a house will be constructed at Station 8 for a truck driver, and one at Station 9 for a meter inspector. A meter inspector is responsible for the operation and maintenance of the meter equipment.

(Counsel handed the reporter a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Operation and Maintenance, Pipeline Department, Witness R. G. Strong," which, at the direction of the Examiner, was marked Exhibit 110 for identification.)

The subject matter dealt with on page 1 of Exhibit 110 is set out more in detail on page 2. Line 2, entitled "Natural Gas Pipeline Company of America," is set out in more detail on page 7 of the exhibit. The detail of

Lines 1, 2 and 3, page 2 of the exhibit, entitled "Gathering System, District No. 1;" "District No. 2," and "Booster Stations," is set out more fully on pages 3, 4 and 5 of the exhibit.

Passing to page 3, the items on Lines 1, 2, 3, 4 and 5, for the years 1939 to 1954, inclusive, were calculated by determining a unit cost per mile of pipeline installed as an average in the years 1936, 1937 and 1938. In
732 other words, the unit costs were prepared from the actual cost of operating the gathering system in those three years.

I mean the unit cost per mile of pipeline installed was calculated in that manner. That factor unit cost per mile per year was applied to the miles of pipe which are to be added in each year from 1939 to 1954. The same explanation is given for material, for car and truck, and for damages, with the exception that when we are required to pay damages or to pay for repairs to equipment such as pipe repairs, coupling repairs, repairs that have not heretofore been done, those damages and repairs will be added to the unit cost as projected in each of the years. The traveling expense shown in Line 5 is projected on a unit cost per mile basis.

Under Line 6, "Meters and Regulators," a unit cost was developed from the actual expense from 1936 through 1938 based on the number of meters serviced during each of those three years. That unit cost was applied in projecting the cost from 1939 to 1954, inclusive, based on the number of meters to be added to the gathering system in each of those years. That in turn is, of course, based on the number of wells to be drilled, as shown by the testimony of Mr. Bussard and set out in his Exhibit 100.

The cost of material and labor was arrived at by a unit cost, not by using the prices of June 1, 1939, representing an average actual cost during the years 1936, 1937 and 1938. We have certain items such as repairs to pipe, repairs to drips, the cost of replacing a drip, that is, the reclaim cost of replacing a drip, the reclaim of lateral lines, the cost of the reclaim, repairing river lines, all of which is work that is not represented by the actual unit cost arrived at for these years 1936, 1937 and 1938.

In determining the cost of labor that goes into operation and maintenance, we developed a unit cost from actual expense incurred from actual operation over the three

year period, 1936, 1937 and 1938. We applied that unit cost to the number of miles of pipeline we expect to have in place during the years 1939, 1940, and so on. That would apply to the material as far as the unit cost developed is concerned.

The labor costs on June 1, 1939, were practically the same as for the years 1936 to 1938, inclusive. I think I can say they were the same, as I do not remember any changes that may have taken place during that period of time. The only difference would be the decrease in the number of working hours, which might affect the cost of operation, and that would tend to increase the labor costs above the average that I have used in projecting this expense. In other words, if I had used the June 1, 1939, labor cost, taking into consideration the decreased labor hours, it would show a greater amount.

Items 8, 9 and 10, under "Maintenance," were arrived at in the same manner as explained under "Operation," by determining the unit cost per mile of maintaining 733 the lines during the years 1936, 1937 and 1938. To those costs as shown for the years 1939 to 1954, inclusive, I have added the expense of material, labor, transportation, and car and truck applying to the additional miles of pipe that would be added to the gathering system.

Cross-Examination Interposed by Mr. Slaff.

For each of the years after 1939 we have two factors, one the unit cost per mile that we have developed over the three year period 1936 to 1938, inclusive, applied to the number of miles of pipe we expect to have in place. Then there is an additional item of expense for each year for certain operation and maintenance for which we cannot or have not developed unit costs. There is no detail of that breakdown. The detail is shown in my working papers.

Direct Examination by Mr. Hedrick.

These working papers will be available to counsel and their engineers at their and my convenience.

Line 11, "Meters and Regulators," was calculated from the unit cost of actual maintenance of the meters and regulators installed during the years 1936, 1937 and 1938, applied to the meters and regulators to be added to the

gathering system in the years 1939 to 1954, inclusive, which is based on the number of wells that are to be added to the gathering system during those years, as shown in Exhibit 100.

Cross-Examination Interposed by Mr. Slaff.

The total mileage of pipe in the gathering system as of January 1st of each of the years to which I will refer is as follows: 1939, 230; 1940, 248; 1941, 272; 1942, 288; 1943, 309; 1944, 321; 1945, 336; 1946, 357; 1947, 382; 1948, 398; 1949, 411, 1950, 419; 1951, 426; 1952, 426; 1953, 426; and 1954, 426.

The miles of pipe in the gathering system as of January 1, 1936, were 191; 1937, 206; and 1938, 220. The number of meters and regulators as of January 1, 1936, was 110; 1937, 128; and 1938, 149.

No, I did not use the figures of pipeline in existence as of January 1, 1939, January 1, 1938, and January 1, 1937. I used the figures as of January 1 of the years 1936, 1937 and 1938. Those are the methods that two different people might use. In arriving at this cost I used the pipe that was in place the first of those three years. The pipe that was installed during 1936 was picked up and used as an average during the year 1937. The pipe that was installed in 1938, added to the pipe that was in place on January 1 of that year, will give you the pipe in place as of January 1, 1939, which, with these factors applied, will give you the amount shown under the column "1939."

734 I took the total amount of pipe in place as of January 1, 1936, the total in place on January 1, the following year, that is, the sum of the pipe that was installed during the year 1936 added to the amount that was in place January 1, 1936. That gives you the quantity of pipe which I used for the year 1937.

You ask if in order to get the amount of pipe for that full year 1938 I had to take into consideration the figure I gave you of pipe in place as of January 1, 1939. The answer is no. I gave you the figure of pipe that was in place January 1, 1938. The pipe added during 1938 was not picked up until the year 1939, and then was applied to the January 1, 1939, figures. To be absolutely correct I think you have this in mind: it would be necessary to calculate a weighted average by months or to the extent of weeks, if we want to carry it that far. I realize there is a chance for confusion in here.

Direct Examination by Mr. Hedrick.

Proceeding to page 4 of Exhibit 110, Line 1, entitled "Horse Power," during the years 1938 to 1954, inclusive, refers to gas engine compressors which are to be installed in what we have termed the booster stations. These have a nominal rating of 40 horse power for each compressor gas engine driven unit.

Under the sub-head "Operation" on page 4 of this exhibit, the cost of operating labor was determined from the actual operating expense which we have had in connection with servicing meters and regulators throughout the gathering system. We have determined that a booster station will require twice the amount of servicing that a meter will require; therefore, we have doubled the operating labor expense shown for the years 1936, 1937 and 1938 and applied that as a factor for determining the cost of booster station operation labor, as shown in Line 2, page 4, in the years 1939 to 1954, inclusive. The year 1938 reflects the actual operating labor expense. That expense is by no means comparable to what in our judgment will be the future expense of operating booster stations. It is much higher on account of the experimental type of operation of the booster station which is now in place. We have been required to pay considerable attention to that unit to determine its operating characteristics. I do not expect the 1938 cost to continue throughout the years 1939 to 1954, inclusive.

Line 3 shows the cost of material for operating the units. This consists largely of lubricating oil and expense for small tools, gasoline, kerosene, waste, rags, etc. We have determined this expense to be $4.50 per horse power per year, wich applied to the horse power installed for each of the years shown, with the exception of 1938, will give the total material operating cost. The 1938 cost of material is lower than the 1939 cost of material for the reason that the station was placed in operation in May, 1938, and was not operated for the full year.

735 Referring to the sub-heading "Maintenance" in Line 6, we determined the cost for maintenance labor by the expense of maintaining personnel, that is, foremen, mechanics and helpers to be used in the maintenance of this equipment. This also includes the transportation of these men about the gathering system. From that study we determined that the cost per horse power per year would

be $4.60, and that factor was used in determining the expense of maintenance labor for the years 1939 to 1954, inclusive.

The maintenance material cost shown in Line 7 was determined by listing the repair parts which in our judgment will be required for the proper maintenance of these units during their existence in the gathering system. The maintenance material cost per horse power per year was determined to be $1.65, and, with the exception of 1938, which reflects actual expense, maintenance material costs were arrived at by multiplying this factor times the horse power installed for each of the years 1939 to 1954, inclusive. In 1954, 80 units will not be operated. Therefore, the total horse power operated will be decreased to the extent of 80 units.

As the additional booster station units are installed, as shown by Mr. Bussard's Exhibit 100 and as shown in the first line on page 4 of Exhibit 110, the costs for the operation and maintenance of those stations and units will increase in accordance with the increase in number of stations and units. I wish to explain that in 1952 the maintenance cost for labor and material has an added amount to cover the cost of reclaiming 25 forty horse power units. That amounts to $4,125 for labor and material, so in checking the expense for 1952 that cost of reclaim will have to be considered.

Cross-Examination Interposed by Mr. Slaff.

The fuel cost for operating the booster stations was determined by actual metered measurements of the gas used in the presently existing booster station. These quantities were applied to the adidtional units as they were installed in the respective years, or are to be installed in the respective years, 1939 to 1954. The cost of that fuel was calculated on the basis of 4¢ per MCF.

Direct Examination by Mr. Hedrick.

Referring to Lines 1 to 6 on page 5 of this exhibit, for the years 1939 to 1954, inclusive, those amounts were determined from our actual past experience as to expenditures and the work represented thereby. In addition, we have determined what in our judgment will have to be done to properly operate this pipeline system and to maintain the efficient organization and personnel that will be required to

operate it under the load factors that will obtain. In this connection, as the property becomes older, more operating expense will be required. This includes additional expense for patrolling and walking the line and for the determination and finding of defects in the underground structure. The operating material and car and truck will have additional expense caused by the added program for patrolling and walking the pipeline.

736 The difference between the 1936-1938 average of $3,461 for operating labor and the 1939-1954 average of $4,350 is $889 per year, or approximately $75 a month. That represents one man employed about 50% of the year for additional patrolling.

Cross-Examination Interposed by Mr. Slaff.

You ask what is the explanation for the large figure shown in Line 2 for operating material for 1938. There is an item of expense in operating material for 1938 that in our judgment will not reoccur. The expense shown for 1939 represents more nearly, in our judgment, what the actual expense will be in that year and in subsequent years. If I had used the 1939 figure in 1938, instead of being $968 it would be around $450 or $460.

Direct Examination by Mr. Hedrick.

The car and truck expense is for additional transportation used in patrolling the pipeline as the necessity for patrolling increases during the succeeding years.

"Damages" represent the item of payment to landowners or farmers for the damage to land and property, fences, private roads and so forth, crops, cattle and other stock.

Except for the gathering system, we have used prices of labor and material as they existed on June 1, 1939.

The item of "Traveling Expenses" is the expense of personnel from the Chicago office making inspection trips to the field to determine what work should be done, how it should be done, and when it should be done. That expense does not include the field personnel expense.

The next item is "Meters and Regulators." Those amounts are for the operation of the meters and regulators, and, in our judgment, will have to be expended for the years 1939 to 1954, inclusive, as shown in this exhibit.

"Maintenance Labor" covers the labor expense of making all repairs to the pipeline structure, such as repairs to back fill, erosion protection, repairs to roads, repairs to pipe, repairs to couplings, repairs to valves and fittings, and also the cost of retiring structures from the pipeline as explained under capital expenditures. The whole program of maintenance is one of prevention, that is, the determination of what work has to be done from time to time is based upon a program of prevention rather than cure.

The average for maintenance labor for 1936-1938 was $5,757, and the average for 1939-1954 is $15,637, or a difference of approximately $9,880 a year, or $824 a month, for the line represented by District 2. That represents a personnel of one foreman and six men, the additional average that will be employed for maintenance labor over the subsequent years of the project as represented by this exhibit.

737. For "Maintenance Material" the amounts represent the cost of all material entering into the proper maintenance of the pipeline system, such as material for the construction of erosion dams, repairs to fences, repairs to roads, repairs to back fill, repairs to valves and fittings, repairs to pipe, repairs to couplings, and all material costs entering into maintenance of any part of the pipeline system.

The term of "Car and Truck" shows amounts to be expended in the operation of the company for automotive equipment, including trucks, teams and wagons, or any items of transportation that will be required in connection with the maintenance program.

The item of "Meters and Regulators" includes the maintenance labor and material for the maintenance of the meters and regulators as they become worn and deteriorate over the years 1939 to 1954, inclusive.

Through inadvertence in typing, there is no page 6 in this exhibit.

The recapitulation on page 7 includes the amounts shown on pages 8 to 14, inclusive.

The figures set forth on pages 7 to 12, inclusive, concerning operation and maintenance in Districts 3 to 6, inclusive, were determined in the same way as I determined the operating and maintenance costs of District 2.

This recapitulation on page 7 includes the operation and maintenance of the branch lines shown on page 13 and the

Joliet meter and regulator stations shown on page 14, as well as on pages 8 to 12, inclusive.

I arrived at the cost of operation and maintenance of the pipeline of Natural Gas Pipeline Company, Districts 3 to 6, inclusive, in the same manner as I have described in connection with the operation and maintenance of District 2 of Texoma Natural Gas Company, about which I have testified in detail and which is shown on page 5 of Exhibit 110.

It is my considered judgment, based on my experience as I have stated it, upon my knowledge of the pipeline, machinery, equipment and other property of defendants, of the demands upon the same in the course of each defendant's operations and the physical conditions existing along the course of each of the companies' pipeline and property, that, at the prevailing costs of labor and material as of June 1, 1939, as I have described, and at the unit costs which I used and which I have described in my testimony, these amounts set forth at the respective dates shown in Exhibit 110 will be expended by defendants in the operation and maintenance of their properties.

(Exhibit 110 was offered in evidence.)

I stated that in so far as gathering lines of Texoma
738 Natural Gas Company are concerned, I used the average of 1936 to 1938, inclusive, in determining unit costs and applied those costs to the future expenditures for operation and maintenance of the gathering lines of Texoma, which costs I stated were about the same or less than the prices as they existed on June 1, 1939; but so far as the balance of the operation and maintenance of the properties of defendants are concerned I used the prices that were in existence on June 1, 1939.

When I stated that in my judgment the figures shown in Exhibit 110 would be expended as set forth therein, I was referring to unit costs in those places where I actually used unit costs in my testimony. I was using the prices as of June 1, 1939 as to future property in accordance with my testimony.

(EXHIBIT 110 was received in evidence over the objection of counsel for each of the two Commissions, who were allowed an exception.)

Cross-Examination Interposed by Mr. Slaff.

The figure for labor and maintenance expense shown on page 7 of Exhibit 110 includes labor cost incurred in the retirement of the property.

The item of $144,613 for material cost in 1936, shown in Line 9, is substantially different from such costs for the years 1935 and 1937. This is due to the fact that in addition to the regular maintenance expense that item includes material used in reconditioning and relaying the Cimarron River crossing, and reconstructing, reconditioning and relaying 12,545 feet of 12 inch pipe and 3,636 feet of 24 inch line and installing 294 chance anchors, and replacing of the 24 inch line with two 18 inch lines in Silver Creek. That is the cost of the reclaim or retirement, including both labor and material used in the connection. It would include the cost of the material used in the reclaim or the retirement of the 24 inch line and the lowering of two 18 inch lines across the North Skunk River. Those are the items which go to make that up. There may be additional items for which I do not have the details here. That is something that would have to be taken from the accounting records of the company.

Those are the items a statement of which is contained along with a statement of other items on page 18 of Exhibit 105, and those items, as I have stated, were charged to maintenance expense rather than to fixed capital. Our maintenance expense, labor and material, for the year 1938 includes some $42,000 expense incurred in connection with the Sheffield break of which I spoke this morning.

Direct Examination by Mr. Hedrick.

When I stated that the items which I have mentioned are included in the expenditure of $144,613.02 in 1936 for
739 maintenance material in response to Mr. Slaff's question as to whether all the items on page 18 of Exhibit 105 were maintenance, I meant that only those items which I mentioned were charged to maintenance.

The other items on page 18 were expenditures direct to capital investment for additions to the physical property which did not exist prior to that expenditure.

The total amount shown on page 18 for work on river lines and loop lines for defendants is approximately $1,008,110, and of that amount approximately $206,820

was charged to maintenance material and labor. The difference, approximately $801,289, was charged to capital investment.

Cross-Examination Interposed by Mr. Slaff.

The expense of retiring the old line is charged to maintenance and that is all that was charged to maintenance expense in connection with that item.

I testified in a lawsuit to which Mr. E. V. Kesinger referred in his testimony, at Tulsa, Oklahoma, Henry L. Lemons *vs.* Natural Gas Pipeline Company of America. I also testified in a damage suit referred to by Mr. W. H. Davidson, in the County Court at Joliet, Illinois. I have not testified in any rate case before coming with defendant.

740 W. T. BULLA, a witness for defendants, testified:

Direct Examination by Mr. Hedrick.

(August 2, 1939.)

My name is W. T. Bulla. I live at Western Springs, Illinois. I am 44 years old.

My grammar school education and business school course, including telegraphy, was completed in 1911, at Parsons, Kansas, after which I completed a number of home study courses covering communication engineering, mostly courses of the American Telephone and Telegraph Company.

From September 1, 1911, until August 1, 1917, I was employed by the Missouri and Kansas Telephone Company, which later became known as Southwestern Bell Telephone Company, in various capacities. I worked as a line man for a little over a year in Parsons, Kansas; as construction clerk and telegraph operator at Joplin, Missouri, for approximately one year; as wire chief in charge of plant facilities at Chanute, Kansas, for approximately two and one-half years; and as toll tester, handling special circuits, at Kansas City, Missouri, for a little over one year. During my employment with this Bell system company I had the opportunity to gain experience in several phases of communication service.

From August, 1917, until June 1, 1930, I was employed

by the Empire Companies, with headquarters in Bartlesville, Oklahoma, in the telephone and telegraph department, six years of which I was in charge of telephone and telegraph operations, carrying the title of wire chief; and four years of which I was assistant superintendent of telephone and telegraph, during which time I had general supervision of operation and maintenance as well as a number of construction projects; and three years of which I was superintendent of telephone and telegraph.

During my service with the Empire Companies I continued my experience in operation and maintenance and also supervised the construction of several hundred miles of pole and wire facilities in Kansas, Oklahoma and Texas.

Between January and the latter part of April, 1930, I covered the territory between Amarillo, Texas, and Chicago, Illinois, some of it the second time, to secure data, on the request of Mr. E. V. Kesinger, with which to make a recommendation for a communication system for the proposed gas pipeline, which is now the property of Texoma Natural Gas Company and Natural Gas Pipeline Company of America. This information was transmitted to Mr. Kesinger, Mr. Floyd C. Brown and others at conferences held in Bartlesville, Oklahoma, New York City and Kansas City.

From June 1, 1930, until July 1, 1931, I was employed by the Continental Construction Corporation, the name which has been changed to Natural Gas Pipeline Company of America. My duties were to supervise the construc-
741 tion of the communication system as it now exists. I am designated superintendent of telephone and gas dispatching.

As the supervisor in charge of gas dispatching I have a group of dispatchers under my supervision, one of whom is on duty at all times. By that, I mean 24 hours per day in the Chicago office, to coordinate the activities of the various departments of these companies in so far as delivery of gas is concerned through the system, and to issue orders pertaining to the operation of this system in accordance with the instructions and policy outlined to them.

It comes within my jurisdiction and is my responsibility to give orders through these dispatchers covering the operation of gas compressor stations, the number of engines to be operated, and the speed at which these units are to run; also to give orders or authorization prior to the opening or closing of any valves or gates that can affect in any

way our ability to deliver the maximum rated capacity of this gas pipeline. We necessarily contact each of the ten compressor stations, and also the Joliet measuring station, each hour of each day and night.

If, for instance, Mr. Strong, superintendent of the pipeline department, should wish to close a pipeline gate and shut out the flow of gas in order to make a repair to the pipeline, he is required to obtain authorization from me to close that gate. That is the common practice of the company. If Mr. W. H. Davidson or Mr. Powers should wish to shut down an engine, outside of an emergency, the operator of the station would have to obtain an authorization from me before shutting it down.

To facilitate our work, we have a company owned communication system over which we are able to contact the various departments and operators and over which we dispatchers have right of way. The set-up in general might be compared to the train dispatching system of a railroad. To function properly in my work I must have, and I do have, contact with various utility customers to whom we sell gas in order that I may ascertain the quantity of gas that they require, so that, if gas is offered to a customer and he is unable to use it, I may endeavor to sell it to some customer who is in position to use it.

For the same reason as previously given, the dispatcher must authorize the shutting down of a compressor station when the operators desire to do repair work on equipment, such as the cooling system. In fact, the operating departments and the construction departments must cooperate to the fullest extent so that we may plan considerably in advance any work that is contemplated, so that it will occur at a time when we anticipate the requirements of the utility customer to be the lowest, or at a time when the curtailment to these utilities will have the least effect. Plans are made months in advance for most of such work. When I refer to utility customers, I refer to any customer with whom we have a contract to deliver gas.

Several months ago, Mr. R. G. Strong, superintendent of pipelines, advised me of work on the 24 inch main line
742 which his department would like to do during the summer of 1939, stating that sections of pipe on main line gates were to be replaced due to faults found. Also Mr. R. T. Powers and Mr. W. H. Davidson, in charge of compressor stations, advised of work at various compressor stations under their jurisdiction, all of which would re-

quire shutting out sections of main line or being unable to operate certain compressor stations for a few hours while the work was being completed.

Having this data I was then able to contact our utility customers and secure their estimates for periods when we might expect their gas requirements to be less than normal, or when they felt that curtailments to them would be the least harmful, and with this information I was then in a position to work out a program with the other departments for the work contemplated.

It is with a great deal of satisfaction that we find on consulting a calendar such holiday periods as we had, combining the weekend and July 4th into a three-day period when customer utility requirements would be at a low ebb. A great deal of work both on the pipeline and at compressor stations was accomplished at this time. The same will be true for the weekend of September 2nd, 3rd, and Labor Day on the 4th. Such periods allow us to complete the work scheduled and to get the line pack back to a condition where we can again make normal deliveries to our customers.

The most recent work on the line or stations was on Sunday, July 23, and Sunday, July 30. The work on July 23 as scheduled included work on the pipeline and also some work at compressor stations. Authority had been granted for a certain maximum period of time in which to do the work. The Chicago District Pipeline Company and other utilities had been advised in advance that the quantity of gas available to them would be 25 million less than what was normally offered them on each of two days in which the work occurred. I say two days, because although the work was done during the daylight period of one day, that affects what to us are two days, inasmuch as our contract day starts at 12 o'clock noon.

Compressor Station No. 6 was one of the stations involved, and they were engaged in cleaning their cooling system, taking advantage of the fact that the pipeline was shut out just east of Compressor Station No. 8. They had been authorized to be inoperative for the same period of time, which was deemed necessary for the pipeline work.

However, as mentioned by Mr. W. H. Davidson, a lack of water or water facilities caused a delay which has been felt, or which was felt, for the week following the work, inasmuch as we operated without our usual line pack and

we found it necessary to limit some utility customers to quantities less than what we normally tendered them.

In the case of individual compressor stations being inoperative, the location of the station makes considerable difference in our ability to deliver. If Station No. 1 is down, our entire source of supply for the system is cut off.

However, Station No. 2 being down would necessarily
743 have a much less effect on immediate deliveries than would Station No. 10.

I understand there are a number of jobs to come up in the future by the pipeline and compressor station departments which will require more or less curtailment in our sales during the time or following the time that such work occurs.

(Counsel for defendants handed to the reporter a small map entitled "Natural Gas Pipeline Company and Texoma Natural Gas Company, Telephone and Pipeline System," which, at the direction of the Examiner, was marked Exhibit 111 for identification.)

Exhibit 111 is a layout of the telephone communication system. It shows the relation between the communication system and the pipeline. The broken line indicates the general route of the pipeline, whereas the solid, or, I might say, the crooked line indicates the communication facilities.

This system is divided, in that that part of it south of the point indicated by the arrow in the corner of Nebraska is our own company owned pole line, whereas that part of it from that point east across Nebraska, Iowa and Illinois consists of company owned wires and necessary fixtures in place on other companies' poles, for the most part, with the exception that each of the branch lines has a portion of them on company owned poles. For instance, in Iowa, where the figures 7, 8 and 9 occur, and in Illinois where the figure 10 occurs, part of the line is on our poles and part on the poles of other companies.

I might best describe the wire facilities by saying that so far as the main line is concerned, it consists of a four wire system by which we derive three talking circuits, and it is possible to derive a number of telegraph circuits. In so far as we are concerned, we have only one telegraph circuit set up. This system, in general, is known as a magneto system. You might liken it in that respect to the farm lines. In other words, the telephones used are of the hand generator type which you crank to signal other

stations or the operators. The circuits are metallic circuits. The conductivity is very high, and the transmission equivalents are good. It is likened to a long haul toll circuit of commercial telephone companies. We use telephone receivers, telephone ringing equipment which pick up weak signals and re-amplify them on, as is necessary on any long haul circuit.

(EXHIBIT 111 was offered and received in evidence without objection.)

Cross-Examination Interposed by Mr. Slaff.

On the main line, the pole line from just south of Station No. 6 up to Chicago is on the property of the C. B. & Q. Railroad. Some of the branch lines are on telephone company poles and some are owned by us.

744 *Direct Examination by Mr. Hedrick.*

From Station No. 6 to Chicago, the wires of the company are generally, so far as the main line is concerned, on the C. B. & Q. poles.

(Counsel for defendants handed to the reporter a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Additional Capital Expenditures and Operation and Maintenance, Telephone Department, Witness W. T. Bulla," which, at the direction of the Examiner, was marked Exhibit 112 for identification.)

I am requested to refer to Exhibit 112, page 1, and, under the sub-heading "Additional Capital Expenditures," explain Line 1, entitled "Radio Communication Equipment," showing expenditures in 1940, 1943, 1945, 1948, and 1950, and state the necessity for those expenditures.

By referring to Exhibit 111 you will note that the route of the telephone line deviates somewhat from that of the pipeline, and we found it necessary in 1938 to secure certain radio equipment to use in addition to our other communication facilities so that communication might be provided whereby we could better coordinate our work, particularly in emergencies, so that line breaks or emergency work could be completed in the minimum time and thereby limit the loss in revenue due to decreased gas sales on account of breaks.

It is the general feeling that the north end of the pipeline system is the more important, the reason for this

being that it is closer to the markets, so that if an interruption occurs due to a main line break it will affect the customer so much quicker that it behooves us to make repairs as quickly as possible on that end of the system, even more quickly than is required on the south end of the system.

We decided in the early part of 1938 that it would be helpful if we provided a limited amount of radio telephone equipment, and proceeded to secure licenses from the Federal Communication Commission, and purchased and installed the necessary equipment to so equip radio transmitting stations at each of Stations 6 to 10, inclusive. We had practically no difficulty in convincing the Federal Communication Commission of the necessity for the operation of these radio sets.

We also provided one additional set as a portable emergency unit. By that I mean a transmitter. We also provided receiving sets to go with each transmitter, also automobile type receiving sets similar to that used by law enforcement bodies, and after equipping a number of company cars and trucks, we were then in a position to broadcast information when emergencies occurred.

When an emergency occurs it behooves us to notify pipeline department supervisors, their crews, and others who may have receiving sets in their company cars as quickly as possible. With this equipment we are able to broadcast information when emergencies occur to give them the location, if it is known at that time or as soon as it
745 does become known, and thus do coordinate the work of getting men and material to the emergency as quickly as possible.

It was rather difficult to secure equipment for this particular purpose, due to the fact that the Federal Communication Commission placed certain limits on the type of equipment that can be operated by the class of operators which we can afford to provide and have the project be economical. What I am getting at is that these stations are limited in power, and to increase that power so that one large station might be used instead of several smaller power stations would require the constant service of operators so qualified that we would have to employ specialists for this duty, whereas with the type of equipment which we have secured we can use a limited amount of specialists, which, for the most part, we already had in our telephone organization, and with some home study

courses and the passing of a somewhat easy Federal examination, we can take our regular employees, such as clerks, and qualify them to handle this equipment.

In 1938, as before stated, we purchased equipment costing $6,000. We have since that time been endeavoring to sell the management of our company on the idea of placing additional equipment on the south end of the system of Natural Gas Pipeline Company and on the system of Texoma Natural Gas Company. I am of the opinion at this time that they will allow that expenditure in 1940, and it has been set forth in that year to cost $8,000. We do not estimate the life of this equipment to be more than five years. Therefore, the same amount reoccurs in 1945 and in 1950, being replacements of the radio communication equipment to be purchased in 1940. The expenditure in 1943 will be to replace the radio equipment purchased in 1938, and the same also applies in 1948. The equipment to be purchased in 1940 is for a different group of locations, so that it would not necessarily be the same as that purchased in 1938.

I feel that the expenditure in 1938 for the north end of the line has been fully justified. The radio equipment has been instrumental in providing communication which facilitated the work previously mentioned on July 23rd and July 30th, in that it allowed one supervisor to keep in contact with several repair jobs that were in progress at the same time in various locations.

Counsel has inquired how we would communicate with the compressor stations or the Chicago office without the radio communication equipment if we had a shutdown or a break where the line crosses the Mississippi River between Iowa and Illinois, which is considerably removed from the telephone line.

We have already had an experience where supervisors and trucks were traveling along the highway when they were needed elsewhere on the system, and when information was broadcast to them that an emergency existed, giving them the location, they acknowledge the receipt of
the radio request within fifteen minutes of the time it
746 was broadcast. If it had not been for this means of
communication it would have been necessary to send a messenger by car or to endeavor to intercept these employees at some point they might pass on their way to their destination.

I do not believe I answered the question I was asked

about means of communication if we had occasion to call cars and trucks for an emergency existing over on the Mississippi River. Using the radio, we would be able to call those employees immediately, whereas if we did not have that, it would be necessary to send messengers to the locations where they were thought to be, telling them of this, which would cause considerable delay.

The operators are not able to get the base ball games on these radio receivers. So far as the transmitting equipment is concerned, we are definitely limited to a certain wave length and assignment of a certain kilocycle on which we can operate. We cannot operate on any other wave length. The receiving equipment is not quite the same. We have to convert it, but it is locked on one frequency. They cannot listen in to regular program broadcasts. It is impossible for them to do that.

As to how we would locate a man who had radio receiving equipment on his car, we know the car numbers. There is a car of a certain number assigned to that employee. We know that employee is driving that company car. If we wanted that individual we would call for car number so and so. An example of that would be if an employee working out of Station No. 10 was en route somewhere or working at some place on the system, the operator in charge of the transmitting equipment would go on the air, announce his call letters, and say that he was calling Car No. 350. "Calling Car 350," repeating that until he felt sure that the employee who had such car had heard it.

If he does not have his receiving equipment switch turned on, we do not have a device for notifying him to turn it on. We have experimented on some such plan; but we do not have anything in operation. Our present plan of operation is that on the half hour of each hour when an employee driving a car so equipped with a receiving set is out away from his headquarters, he will turn that set on for a reasonable period, say about five minutes, on the half hour of each hour, so that he might hear any information that might be sent out.

Cross-Examination Interposed by Mr. Slaff.

I believe it is true that the price of the equipment which I used as of June 1, 1939, speaking of radio equipment, is identical with the price of the equipment installed in 1938.

The prices of June 1, 1939, were used in determining the prices for the labor, material and equipment referred to in Exhibit 112, for the entire exhibit.

Line 2 is entitled "Voice Repeaters." These voice
747 repeaters are in reality voice amplifiers. In other words, in talking out over the telephone circuit, after traveling a certain distance, the volume will be dissipated. We pick up the volume and repeat it or reamplify it, so that it will carry on in about the same volume at which it originated. We contemplate that it will be necessary to replace the existing voice repeaters, nine in number, in 1943, at a cost of $4,650. These voice-repeaters wear out so that they need replacement. They are rather delicate instruments, consisting of transformers, small relays with minute parts on them, and due to constant wear on these parts we anticipate it will be necessary to replace them entirely. It is our experience that they wear out within the period of time described by me. Those are Western Electric repeaters.

Line 3 is entitled "Ringing Equipment," and shows an expenditure in 1943. The ringing equipment as used on our communication system is somewhat similar to voice amplifiers, in that we pick up the ringing current when it becomes dissipated and resend it over the same cycles in an added volume so that it may be heard over long distances. This item is the replacement of the present existing signal equipment, which is also rather delicate equipment, and I anticipate that it will be necessary to replace it wholly in 1943, or prior to that date, on account of its wearing out. Most of the equipment was installed in 1931.

Line 4 is entitled "News Crossing Canadian River," and shows an expenditure of $3,000 in 1945. This is the Canadian River aerial telephone crossing on the part of the system of Texoma Natural Gas Company near Sanford, Texas. At the point where we cross, the span from fixture to fixture is some 2400 feet. It is very rocky and rugged country. Extreme winds are experienced there and we have had difficulty at or near the same location in previous years. This crossing has been replaced once since it was originally constructed, and we deem it necessary to replace this crossing again, probably before 1945. It is pretty much of a guess as to when it will be necessary, but I doubt if it will last any longer than 1945. The figure we

have used for 1945 is equal to the figure that stands for our actual expenditure on the first replacement. If you will look at Item 11 on page 1, you will see that in 1946 we have the retirement of this crossing, which on our books is $2,792. We will retire it in 1946, the following year. We cannot retire that crossing until the new one is erected and ready for service.

The part of the crossing that wears out is principally the wire. The wind load, or ice load, when that exists, causes a continual flexing of that wire so that it will crystallize. That is principally at the points where it is tied in. However, we do not deem it advisable to splice that wire in the middle of the span or out in any part of the span. It is so difficult to erect those wires across that stream that we feel that we should put in new wire, and the old wire is taken away in such condition that it cannot be used. I think we would still have that flexing if we suspended the wire from a cable. We would have it in the cable then, as well.

Line 5 is entitled "New Lines Telephone Service—Skellytown," and shows an expenditure of $3,019 in 1942. Skellytown as referred to in this exhibit will be found on 748 Exhibit 101. We contemplate the construction of approximately five miles of pole line, with the necessary wires and pole facilities, to extend a telephone line from the present existing gathering system to a proposed camp to be established by the company in the vicinity of Skellytown, Texas, in 1942.

On Exhibit 101 the existing telephone lines are indicated by a solid green line. The proposed lines to be constructed are indicated by a broken green line. The proposed camp site at Skellytown is in the northeastern part of Carson County. We propose to extend that line west from Skellytown a half mile and then south to the present telephone lines.

The proposed booster stations in the southwest part of Moore County will have as a central location a booster station known as M-26, which will be located in Section 29, Block P.Mc., E.L.R.R. Survey, in Moore County, Texas. The expenditure in 1945 of $4,472 for new telephone service at Kilgore is to extend communication service to those points where it is felt it is needed.

Page 1 of Exhibit 112 shows the book cost of equipment retired in connection with the additional capital expenditures shown on that sheet.

You ask me to refer to Line 2 under "Additional Capital Expenditures," which shows $4,650 expenditure, and Line 9, under "Book Cost of Equipment Retired," which shows an amount of $2,694, and explain the difference in those two items.

At the time this equipment was placed in service, the only reliable source of supply was the American Telephone and Telegraph Company, which had these items of equipment manufactured for their use or for leasing to customers, where they approved of the use of such equipment, so that for a number of years we secured the use of this equipment on a rental basis. However, after we used this equipment for a few years it became the policy of the American Telephone and Telegraph Company to sell such equipment to us and to give us certain credits for rental which had been paid on this equipment, which would be applied to the purchase price. That is the reason why the retirement cost is less than the purchase of new equipment. It is my judgment that the equipment cost about the same money, or probably more, at the time we started leasing it.

Cross-Examination Interposed by Mr. Slaff.

I do not have the definite date when the change-over was made from a leasing policy to an outright sales policy. It occurs to me that it was about 1936 or 1937. I could determine that, but I do not have it. That was the A.T. & T. itself.

Direct Examination by Mr. Hedrick.

749 I have broken down the additional capital expenditures of the telephone department on pages 3 and 4 of Exhibit 112, page 3 being the additional capital expenditures of Texoma Natural Gas Company and page 4 being additional capital expenditures of Natural Gas Pipeline Company of America, and the totals of the two pages are shown on page 1, from which I have just testified.

I am asked to refer to page 2 of Exhibit 112, entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company. Telephone Department. Operation and Maintenance," and under the heading "Operation" where the first line is entitled "Labor," and to explain how I arrived at the various amounts set out in

that line from 1939 to 1954, inclusive. By using the average of the years 1936 to 1938, inclusive, I determined what the actual expense had been, and knowing the contemplated changes or additions to labor for operation, I was able to project the amounts as shown for the years 1939 to 1954, inclusive. With reference to both operation and maintenance labor shown on page 2, it is my judgment that the cost of those two items will increase somewhat in the years to come.

As to how I arrived at the amounts set opposite Line 2, entitled "Material," on page 2 of Exhibit 112, having the benefit of the record of previous expenses, I was able to project the amounts as shown for the years 1939 to 1954, inclusive, in the same manner as I determined the operation labor.

Line 4 indicates traveling expense of the superintendent of telephone when covering the system supervising operation and maintenance, and in my judgment this expense will materially increase over the average of 1936 to 1938, inclusive, due to the additional time and expense that will be incurred in traveling from point to point to determine work to be done. By this I mean work to be done on our communications system.

Line 5, "Leased Facilities," covers the rentals paid for the use of leased communication circuits, telephone, telegraph, repeaters, and miscellaneous telephone relays, and the principal items are such leased facilities as we have with the C. B. & Q. Railroad Company, where we pay an amount for the privilege of space on their poles and cross arms for our wires.

I arrive at the amount involved by having the benefit of previous costs chargeable to this item, and anticipating that certain rates would be increased or certain additional facilities would be required on which we would pay rental. I might say that we are operating on a contract with the C. B. & Q. Railroad Company which expires in 1945, after which I do not know what the rate will be that we will be required to pay this company for this privilege. We do know that the rate we are now paying, and have been paying, is a rate that is used quite generally by commercial companies to lease space. If anything, it would be my judgment that this rate might be increased, in which case the figures which I have projected will be too low.

Inasmuch as there are no other main pole lines following the general route of our pipeline, if we should be unable to

secure a further contract with the C. B. & Q. Railroad
750 Company, it would probably be necessary that we construct outright a pole line of our own, and a rough estimate of that cost would be in the neighborhood of $1,000,000. At the moment I do not anticipate any difficulty in renewing that contract; but I do not know what the attitude of the railroad company is, inasmuch as I have not consulted them.

Leased circuits from the regular telephone companies would cost a prohibitive amount. With the commercial telephone companies, the practice is to charge for channels rather than physical circuits. In our case, where we string four wires and derive three talking circuits and one or more telegraph circuits, they would not allow such a condition to exist under one of their rental agreements. It would be necessary that we pay for each talking circuit and for each telegraph circuit, and it is my opinion that that would cost double the $32,200 which I have listed as the cost of leased facilities.

Cross-Examination Interposed by Mr. Slaff.

It is true that in that case they would have the burden of capital investment involved which we now have for such wires, poles and so forth.

Direct Examination by Mr. Hedrick.

Our maintenance labor as shown in Line 7 covers the salaries of linemen, groundmen, helpers and other laborers used in maintaining and repairing telephone lines. The average of 1936 to 1938 for those items is materially increased in and after 1939. The reason for that is that our pole line facilities are becoming older, requiring a greater amount of maintenance. As poles become older they will deteriorate, breaking off, causing excess trouble, which will require that we not only clear the trouble, which is an added expense, but also that we use more men, put in more hours, in endeavoring to repair these poles and wires and keep them in an operative condition.

That is partially responsible for the increased cost in 1938 over 1937. Also, in the spring of 1938 we suffered a severe sleet storm which demoralized communication facilities of our company and all commercial companies between the western part of Illinois and central Kansas.

The principal part of the poles in our system are basically 20 foot poles, with a 5 inch top. That is to most people who erect poles a very small pole. Naturally, the circumference at the ground line is small, and although they are treated poles, the rotting condition, the deterioration, will cause the strength of those poles to deteriorate so that the cost of replacing the poles will be much greater as they become older. They are completely treated poles.

The explanation I have given for maintenance labor is about the same explanation I would give for the cost of maintenance material, shown on Line 8 of page 2 of Exhibit 112. I might amplify that by reminding you that 751 basically our pole line consists of 20 foot poles. They cannot be cut off and reset. The amount of clearance that you derive between the surface of the ground and your wires is so small that you cannot follow the practice of cutting off and resetting, as generally practiced by telephone companies.

We use cross arms except on the gathering system, where there are only two wires, and there we use a bracket. We use one cross arm for a pole except at angle points, where we use two cross arms as a matter of safety.

Line 9, covering car and truck expense, covers gasoline, oil, tires, and so forth, for company cars and trucks, and covers hired cars, trucks and teams necessary to provide transportation for linemen and others who have occasion to maintain the telephone system. It is based on information we have as to previous costs, also anticipating that our cost for transportation will increase as we use additional men in maintaining these lines, and in 1946 or 1947 it will cover the additional expense of an additional car for this same purpose of maintaining the lines.

The information contained on page 2 of Exhibit 112 is broken down on pages 5 and 6 of the exhibit, so that on page 5 the operation and maintenance of the telephone department of Texoma Natural Gas Company is shown, and on page 6 the operation and maintenance of the telephone department of Natural Gas Pipeline Company of America is shown. These two sheets merely divide the expense so as to show each company separately. The totals of pages 5 and 6 are shown on page 2, about which I have been testifying.

Cross-Examination Interposed by Mr. Slaff.

In the replacement of poles the labor is charged to "Labor", as shown here on Line 7, and the material is shown under "Material" on Line 8. It is charged to maintenance expense rather than as an addition to the capital account. The same would apply to cross arms, anchors, guys, and all equipment in connection with the pole line. The only time that it might be different is if due to some local condition we had to re-route a line or build an additional mile or two, we would put that under capital.

If it is necessary to replace a pole, the new pole is charged in here as indicated on Line 8. The old pole is taken out of service. Any labor involved in either putting in the new pole or taking out the old pole will be charged to "Labor" as on Line 7. No credit is made to fixed capital for the pole which is taken out of service, and neither is there a charge for the new pole. The charge is made to maintenance expense of the pole which was installed, and no credit is made to fixed capital. We still have one pole. We charge to maintenance the expense of removing the pole which is taken out of service.

Direct Examination by Mr. Hedrick.

752 It is my considered judgment, based on the experience I have stated, upon my knowledge of the telephone system and other property under my supervision, concerning which I have testified, the demand upon this property in the course of each company's operations, and upon the conditions which exist along the line with regard to weather particularly, that, at the prevailing cost of labor and material as of June 1, 1939, the amounts set forth in Exhibit 112 will be expended by defendants for additional capital expenditures and in the operation and the maintenance of the telephone department property on or before the respective dates set forth in Exhibit 112.

(EXHIBIT 112 was offered and received in evidence over the objection of counsel for each of the two Commissions, to whom an exception was allowed. Motion by Commission Counsel to strike testimony of Mr. Bulla denied.)

Cross-Examination by Mr. Slaff.

I have not testified in any other cases.

753 S. E. CAMPBELL, a witness for defendants, testified:

Direct Examination by Mr. Morgan.

(August 2, 1939.)

My name is S. E. Campbell. I live in Kenilworth, Illinois. I am secretary and assistant treasurer of Texoma Natural Gas Company and Natural Gas Pipeline Company of America. I have been in the employment of these two companies since they originated in 1930.

I graduated from the University of Kansas with a B.S. degree in mechanical engineering, and immediately after that I joined the employment of the Cities Service Company in what is known as the Empire Companies at Bartlesville, Oklahoma. That was in July, 1916. I was first an engineer in what they term their junior engineering course. Shortly after that I was taken off the course and placed on the construction and operation of a gasoline plant at Caney, Kansas. I was later superintendent of that plant until May, 1917, when I was transferred, as assistant to the construction engineer, to Okmulgee on the construction of a cracking plant.

From there I joined the army and was in the army until July of 1919, when I returned to the employment of the Empire Companies at Bartlesville, as an engineer. Shortly after that I was placed in charge of their estimating department in the engineering and construction division, and had charge of preparing all their construction estimates.

In 1922, as I recall it, I was made chief clerk of the engineering division, having charge of all of the office personnel and all of the field accounting in connection with the construction work of that engineering division.

In 1926 I was taken off that work and placed in charge of the design and construction of compressor stations and gasoline plants. In 1928 I was made assistant purchasing agent for the Empire Companies, in which position I remained until I joined the Continental Construction Corporation on this Chicago project in the capacity of assistant chief engineer under Mr. Kesinger, the chief engineer.

When the line was completed and put in operation I was assigned the position of superintendent of operations of both Texoma Natural Gas Company and Natural Gas Pipeline Company of America, which position I occupied until

December, 1933, when I took over the duties of the secretary's office. I was assistant secretary for a short period of time, and later, in 1934, I was made secretary and assistant treasurer.

As secretary of these two companies, I have general supervision of the accounting work of the companies. I have the custody of the records of these companies and their books of account, and the accounting personnel perform their duties under my direction.

754 I caused my personnel to give to Mr. Strong and the other operating heads the figures carried into their respective exhibits as book cost of retirements of capital items which they testified would have to be retired from service from time to time during future years. Those figures were taken directly from the books and represent the cost of those items as reflected by the books. I have examined and am familiar with all those exhibits.

In addition to the books of account and the records of the company, I have in my custody the furniture and fixtures for the entire Chicago office and field offices of both defendants. We keep a record of where all this material is, and the field office or other office using this material reports to us its condition. We pass on whether it should be repaired or overhauled or replaced. As a matter of fact, no article of furniture or equipment of any kind can be purchased until I say so.

I have made a study of the future requirements of these two companies for office furniture and fixtures in the various offices maintained by the two companies over their system. This equipment consists principally of desks, tables, chairs, files, drafting room files, or files for maps of the larger type, typewriters, calculators, adding machines, comptometers, duplicators, ditto machines, and, in the Chicago office, water coolers. We find that the mechanical equipment needs replacement periodically. By mechanical equipment I mean such items as adding machines, calculators, comptometers, typewriters, duplicators, drinking fountains, ditto machines, and we also include law books in that category. Some law books become obsolete periodically, and are replaced by later editions, and we consider that a replacement item.

(Counsel presented the reporter a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Additional Capital Expenditures, Furniture and Fixtures," which document, at the direction

of the Examiner, was marked Exhibit 113 for identification.)

Exhibit 113 reflects the additional furniture and fixtures that will be required by defendants from 1939 to 1954. It also reflects the replacements of the necessary furniture and fixtures for the same period of time. It reflects the book cost of furniture and fixtures retired and the salvage of the equipment replaced.

Page 1 of this exhibit is a recapitulation of the additional furniture and fixtures, replacement of furniture and fixtures, book cost of property retired, and salvage, for both Natural Gas Pipeline Company of America and Texoma Natural Gas Company combined, for the years 1939 to 1954, inclusive.

Page 2 shows in detail for Natural Gas Pipeline Company only, the additional furniture and fixtures, replacement of furniture and fixtures, book cost of property retired, and salvage.

755 Page 3 represents the same type of detail as page 2 except it is for Texoma Natural Gas Company only.

On page 2 the first item, "Additional Furniture and Fixtures," followed by lines 2 to 5, inclusive, which have the sub-heads "Calculating Machine," "4-Drawer Filing Cabinets," "5-Drawer Map Filing Cabinets," "Law Books," refers to furniture and fixtures in addition to that which Natural Gas Pipeline Company now has. That is in addition to existing equipment, and is not to replace equipment now on hand.

The calculating machine, in the amount of $585 in 1939, has been purchased and is now in use.

The four-drawer filing cabinets are required in the executive offices and legal department for the filing of corporation records and legal files. Four of these will be required in 1939, and two each in 1940, 1942, 1944, 1946, 1948, 1950 and 1952. The purpose of these files is to take care of the normal growth or increase in the volume of the papers that are put in those files, assuming the normal operations of the company.

The next item, Line 4, referring to 5-drawer map filing cabinets, is to take care of the additional maps in our drafting department in the Chicago office. One of these will be required in 1939, one in 1943, one in 1948, and another in 1953. Those files are to take care of the normal accumulation of maps and other records which are filed away.

The next item, Line 5, entitled "Law Books," is to take care of our additional requirements in our legal department. This item is for the most part an annual service which costs $720 per year. That will be necessary in each of the years from 1939 to 1953, inclusive. That covers the cost of the current bound volumes of the reporter systems that are contained in our legal library. It covers also the text books and other current books that are added to the library each year. This is all in line with our past experience and our present budget.

The item "Replacement of Furniture and Fixtures," the second sub-heading, followed by Lines 8 to 13, inclusive, captioned as shown here in the exhibit, refers to replacement of furniture and fixtures that have become worn out and unserviceable. It does not embrace desks and things that will be used indefinitely, but deals particularly with mechanical equipment.

The first item is "Adding Machines." We have computed the number of machines that will be replaced each year on the basis of our past experience as to the life of these machines and the number of them we have on hand. Two are scheduled to be replaced in 1939 and each of the years following, at a cost of $848 for two machines. This schedule shows the time when those machines will have arrived at the end of their useful lives based on the experience we have already had with that character of equipment and the number of machines which we have in service. This item does not provide for an increase in the number of adding machines at all.

756 The next item shown, Line 9, under the caption "Calculators," provides for replacements likewise on the basis of our past experience as to the life of the machine. Two of these machines will be replaced in 1939; one in 1941, 1942 and 1943, respectively; two in 1945; and one in each of the years 1946, 1947, 1949, 1950, 1951 and 1953.

The next item, Line 10, "Comptometers," is likewise based on their average useful life from our own past history. One will be replaced in 1939, two in 1940, one in 1941, two in 1942, and one in 1943, and so on, as indicated here on the exhibit. I will not repeat the detail.

The next item is "Typewriters." The replacement of typewriters is likewise based on the company's past experience as to the useful life of this equipment. We will replace five in 1939, three of which, I believe, have already

been replaced; five in 1940; six in 1941, and so on throughout as shown, to the year 1953.

The next item is a duplicator which we use to run copies from stencils. It was replaced in 1938. We feel that it will have to be replaced again not later than 1946, and at a cost of $500.

Line 13 refers to drinking fountains. They are the General Electric type, and we have three of them in the Chicago office, one of which was replaced in 1937, one in 1938, and a third will be replaced in 1940. These three machines will again be replaced in 1945, 1946 and 1950, respectively, at a cost of $225 each of those three years.

The next sub-heading is "Book Cost of Property Retired." That refers to the mechanical equipment which I have just testified to under the sub-heading "Replacement of Furniture and Fixtures." Those are the items to be replaced by the items under the sub-caption just mentioned. The amounts set opposite the various items under this caption were taken from the books so far as the items which we now have are concerned. There is an item of $175 for law books under this caption. We have certain services that become obsolete from year to year and retire those services from our furniture and fixtures account. These services are commonly known among the lawyers as advance sheets. When the bound volume comes out the advance sheets are discarded.

The item of "Salvage" represents the trade-in value of the property retired as of June 1, 1939. When we trade in a typewriter or a calculator or a duplicator, or some of these mechanical items, we get an allowance for the old one. This is the schedule of allowances which we receive, assuming that they continue as they were on June 1, 1939.

Going back to the item of "Law Books" for just a moment, the $720 which is scheduled to be expended for law books each year includes the cost of the advance sheets which are discarded when the bound volume comes out.

We will pass now to page 3, which refers to the additional furniture and fixtures and the necessity for replacement of furniture and fixtures of Texoma Natural Gas Company. This refers to those items of equipment listed here which will be required by Texoma Natural Gas Company at
757 its Amarillo office, Fritch office, the field office at Dumas, and the proposed field office at Skellytown. The items listed are directly in line with the drilling program to which Mr. Bussard and Mr. Dickinson have testified,

which will require additional personnel in the Amarillo office and in the Fritch office due to the extension of gathering lines, additional meters, the upkeep of those meters, and additional personnel at Dumas on account of additional gathering lines, requiring additional field foremen. At Skellytown there will be an office established due to the increased gathering system in that vicinity.

The equipment listed is based on the actual requirements of the personnel which will have to be added as the result of the drilling of additional wells and the building of additional gathering lines and the installation of booster stations, all of which we know is inevitable. It is applicable only to that type of personnel that requires office furniture.

In preparing this data I worked directly with Mr. Dickinson and Mr. Strong, as they are the only department heads that will require additional furniture and fixtures. This program is based on their requirements. In my judgment those amounts will be expended on or before the dates indicated here for such items.

Our calculations as to replacements of furniture and fixtures shown on this page have the same meaning as they did on the prior page. It is exactly the same type of equipment. This equipment wears out down there just the same as it does up here. In fact, it wears out more rapidly down there, due to the lack of service facilities and the bad dust conditions under which it has to operate. We have to replace it oftener.

The figures for adding machines, calculating machines, comptometers, typewriters and ditto machines, and so on, are based on the actual schedules for replacing equipment now in service and on the actual cost of that equipment as of June 1, 1939.

The figures under the caption "Book Cost of Property Retired" are arrived at in the same manner as were the figures under the same caption on page 2. The very same procedure was followed in this particular and also in the matter of salvage. The figures shown there represent the trade-in value as of June 1, 1939. All the figures shown here are based on prices as of the date last mentioned.

Cross-Examination Interposed by Mr. Slaff.

The cost figures for capital expenditures, for replacements, and for the trade-in allowances, are based on prices as of June 1, 1939. I am not talking about the book cost

of the property retired. Those costs I have already stated are the actual costs of the articles to be replaced in so far as equipment is now on hand.

758 You ask how it happens that the figures for book cost of property retired coincide with the figures for replacement of furniture and fixtures, the latter being priced as of June 1, 1939 and the former being priced as of the time they were entered on the books of the company. That figure was pulled by the men in our department in charge of the books; and I assume the prices we paid on the equipment we now have are the same as the prices as of June 1, 1939.

Direct Examination by Mr. Morgan.

That would indicate that there has been no change in the prices of adding machines, calculators, comptometers, and so on, from the time we bought them to June 1, 1939. They have all been purchased in the last few years. Those that we originally bought were traded in and replaced some time ago.

(EXHIBIT 113 was offered and received in evidence over the objection of counsel for each of the two Commissions, to whom an exception was allowed. Motion to strike testimony of Mr. Campbell denied and exception noted.)

I have been somewhat familiar with the expenditures known as regulatory expense since 1937. I have made a study of the past and future requirements of defendants for that character of expense incident to regulation to which these companies may become subject. I have made a study of our past cost and have prepared an estimate of what in my judgment this cost will be in the future for both companies.

(Counsel for defendants produced a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Regulatory Expense," which, at the direction of the Examiner, was marked Exhibit 114 for identification.)

The figures shown in Exhibit 114 for the years 1937 and 1938 were taken directly from the company books and represent actual expenditures. In arriving at my estimates for the years 1939, 1940, an so on through the remaining life of defendants, or rather, down through the year 1950, I have consulted with my co-executives, the general manager, the general superintendent, the general counsel, and

others, in an effort to arrive at the best estimate I could of the nature of the regulation to which we may be subjected and the probable cost in connection with such regulation.

At the present time the defendants are subject to regulation by several tribunals, namely, the Federal Power Commission, under the Natural Gas Act; the Securities & Exchange Commission, under the Public Utility Holding Company Act; the National Labor Relations Board, under the Wagner Act; the administrator of the Wage and Hour Act; and, in connection with our radio equipment, the Federal Communication Commission.

These are Federal bodies. We also have the Texas Railroad Commission, which has jurisdiction to some extent in the production and transportation of gas to the point
759 that it is necessary for us to carry on litigation. The Iowa State Commission has regulation of our pipeline only to the extent of the safety requirements. That is all of the state commissions, as far as I know, that have any jurisdiction requiring regulatory expense.

Our estimates of this expense for 1939 and subsequent years are merely our best judgment after consulting with the representatives of defendants as above stated. We have no past history other than 1937 and 1938 on which to base this judgment.

In the light of our expenditures for this year, including those that are already incurred and will necessarily be incurred in connection with the further proceedings in these cases in which this hearing is being held, and from what we can foresee in the future, we feel that $250,000 is a minimum expense this year for the two companies. 20% of that nature of expense is charged to Texoma and the remainder is defrayed by Natural Gas Pipeline Company. No part of these expenses was charged to Texoma in 1937 and 1938. The expenses in those years were incurred in connection with the intervention of Natural Gas Pipeline Company and Texoma in the case between the Illinois Commerce Commission and Chicago District Pipeline Company, which we considered entirely a pipeline matter. We did not charge any part of it to Texoma. Both companies are parties to the present proceeding and we have adopted the policy of apportioning the expense 80% and 20% as above stated. That apportionment applies throughout the remaining years covered by these estimates.

We have incurred no expense as yet in connection with

the National Labor Relations Board or any of these other regulatory bodies which I have mentioned. Our expenses in connection with litigation with the Texas Railroad Commission were charged as straight legal expense at the time they were incurred. As a matter of fact, it was expense incurred in connection with the efforts made by the Texas Railroad Commission to regulate our production down there and is properly chargeable as regulatory expense.

In the light of the consultations I have had with my associates and in the light of my study concerning the probable regulations to which we will be subjected, it is my judgment that these figures represent a reasonable estimate of the expenditures we will be required to make in connection with regulatory bodies.

(EXHIBIT 114 was offered and received in evidence over the objection of counsel for each of the two Commissions, who were allowed an exception. Motion by Commission Counsel and Counsel for Illinois Commerce Commission to strike testimony of Mr. Campbell relating to Exhibit 114 also denied.)

Cross-Examination Interposed by Mr. Slaff.

You ask me to explain the difference for the year 1938 between the figures shown on page 18 of Exhibit 15, put into evidence by Mr. Woodford, which totals $190,788.47 for regulatory expense for the year 1938, and my figure of $175,572.13 for that year. I will check that figure and furnish the explanation, if I can find it, through counsel tomorrow morning.

760 (The following day counsel, in open hearing, explained that the figures shown in Mr. Campbell's exhibit were taken from the books as of September 30, 1938, instead of December 31, 1938, and that the exhibit should be corrected to read: the second line, 1938, $190,788.47; the total to read as of the same amount; and the total at the bottom, 1937 to 1954, inclusive, should read $792,256.10 for Natural Gas Pipeline Company; and should read for both companies $932,256.10 instead of $917,039.76.)

Cross-Examination Interposed by Mr. Booth.

Our estimates include our judgment of what all regulatory expense will cost us in the years between 1940 and 1954. We have made no provision, however, for other rate

cases than the existing rate case. They are just investigations and items of that nature.

Direct Examination by Mr. Morgan.

I have included in these figures my judgment of what the cost of all forms of regulation, all investigations to which we may be subjected, and things of that kind, will be. These estimates, as I have explained, are made in the absence of any history on which to base the figures.

Cross-Examination by Mr. Slaff.

I testified before the Internal Revenue Bureau on the subject of deductions for the determination of income tax for the year 1935 for Natural Gas Pipeline Company of America.

I also testified before the Securities & Exchange Commission in a case of the Texas Company, where they requested exemption from the Public Utility Holding Company Act.

I testified in a tax case between Natural Gas Pipeline Company of America and the State of Kansas on state income tax matters.

You ask for the dates of my testimony. I am not sure that I can give the date I testified before the Securities & Exchange Commission. I will furnish these dates through counsel tomorrow morning.

(Counsel, in open hearing, in compliance with the request with reference to the dates on which Mr. Campbell testified, made the following statement:

Mr. Campbell testified before the Securities & Exchange Commission in re the Texas Company application at Washington on May 8, 1936; and before the District Court of Shawnee County, Kansas, in a proceeding by the Kansas Tax Commission against Natural Gas Pipeline Company of America, at Topeka, Kansas, on March 28, 1938. He testified before the Bureau of Internal Revenue in a proceeding styled "Re Natural Gas Pipeline Company of America" on three occasions at Washington: October 1, 1937; October 12, 1938; and July 5, 1939.)

761 (August 3, 1939.)

(Counsel for defendants made the following statement to the Examiner:

At the time Mr. Kesinger was on the stand, Mr. Booth

requested the names of the industrial customers furnished directly with natural gas by Natural Gas Pipeline Company. Mr. Kesinger has prepared this list and I will read it.

New Jersey Zinc Company, near Depue, Illinois, under a contract dated October 15, 1938, expiring October 28, 1939. Darby Petroleum Company, near Great Bend, Kansas, under a contract dated May 3, 1938, expiring May 3, 1940. Stanolind Pipeline Company, near Great Bend, Kansas, under a contract dated April 6, 1938, expiring April 8, 1940. Northern Gravel Company, near Muscatine, Iowa, under a contract dated August 24, 1936, terminable on thirty days' notice. Palmer Oil Corporation, near Great Bend, Kansas, under a contract dated February 7, 1938, expiring February 7, 1940.)

762 G. M. DAVIDSON, a witness for defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 3, 1939.)

My name is G. M. Davidson. I live in the Village of Wilmette, Illinois. I am chief engineer and superintendent of operations for defendants, which position I have occupied since December, 1933. I have been employed by defendants since July 1, 1931. My first position was that of chief engineer, which position I have held since the beginning of my employment.

I am a graduate in mechanical engineering of Stanford University. I volunteered with the California National Guard in June, 1917, and was drafted into federal service in July, same year, and was overseas from October, 1917, until June, 1919. I served as a second lieutenant and later as a first lieutenant in an engineering regiment with the Rainbow Division. On returning from the army, I was occupied for a few months in a refrigerating plant. I joined the Empire Gas and Fuel Company, engineering department, in November, 1919, and remained with that company until coming with my present employers. From 1920 to 1923, I was field superintendent of a gasoline plant. From 1923 to 1931, I was respectively an engineer in charge of design for the engineering department, superintendent of construction, superintendent of operation, and the last

three or four years I was the general superintendent in the division.

When I first came with defendants, I was not familiar with their pipeline system. It required some time for me to become completely familiar with all of the work that had been done. As chief engineer, I found myself largely occupied in engineering problems of the operating division. Although I was in charge of the engineering department I assumed the work that had not been completed by January 1, 1932 with reference to organizing the operating personnel and matters of that sort. There were many operating problems relating to organization. Since the companies were put in operation, I have had executive supervision of the operating deparments, which includes the communications department, pipeline department, compressor station division, pressure dispatching department; and I also have charge of the purchasing department and the engineering department. I have supervision of the operations at Fritch, of the Texoma gasoline plant and all other activities of that company, except those of the production department in the Panhandle field. Engineering activities are varied in nature and often involve matters of special problems relating to new construction or new economic studies of one character or another. I find that I have to keep up with advances in the industry. That is, I have found it advisable to do this. I think I have told you I work with Mr. Kesinger. The automotive equipment is one branch of our activities which is not delegated to any other operating head. The chief clerk and I keep track of all the automobiles, and have charge of replacements and additions. The purchase and replacements of automobiles, as well as all types of automotive transportation facilities. for both companies, come directly under my supervision. I recommend the purchase of new equipment, but it has to have Mr. Kesinger's endorsement before it is finally approved.

763 I have prepared a study showing the schedule of replacements of this automotive equipment and the probable requirements of the two companies for additional automotive equipment in future years. I don't believe that the exhibit indicates the amount of equipment that we now have in the system except indirectly in that it indicates that which is to be replaced.

(At this point, counsel for defendants handed the reporter a document entitled "Natural Gas Pipeline Com-

pany of America and Texoma Natural Gas Company, Additional Capital Expenditures, Automotive Equipment, Witness—G. M. Davidson," and requested that it be marked for identification as Exhibit No. 115. At the direction of the Examiner, the document was so marked.)

I have before me Exhibit No. 115. Page 1 indicates in three general groups the additions that will be made to capital by reason of automotive equipment. The first group includes all automobiles which will be replaced. The second group on the same page indicates the amount of property retired; that is, the original cost of this equipment written from plant account. The final group is the salvage group for both companies. This really is the trade-in value of the equipment which we are retiring on the purchase of new equipment. This statement includes all additional equipment, whether it is a replacement or an addition to present facilities. The statement is a combined statement for the two companies.

Page 2 is the supporting detail for the recap submitted on page 1, and indicates the equipment which will be replaced and the equipment which will be added by Natural Gas Pipeline Company of America.

Page 3 is a comparable sheet for Texoma Natural Gas Company. These latter two pages indicate the number of units to be replaced and added, but do not indicate any amounts. Turning to the first sub-heading on page 2, referred to as "Chicago Office," you will note that in Lines 1 and 2 there is an R in brackets after these titles. This indicates a replacement of original equipment now on hand. From experience, we have found that these cars are most economically replaced at certain periods of time and mileage. There is a compromise between the two factors, and the replacement of the cars noted in all of the items followed by this bracketed R is based on an experience table. In the light of that experience, we have adopted a definite policy with reference to the time of replacing this equipment. This statement is based on this policy and shows replacements at definite intervals throughout the life of the project, at which times the equipment will be replaced exactly on the basis of our past experience. All purchases following the bracketed R are to be replacements of equipment now in existence or equipment to be acquired hereafter.

Coming to Line 8, you will find that there will be some additional Chevrolet pick-up equipment being added to the

system and, following that through, you will note that there are five Chevrolet pick-ups to be added to all of our equipment in 1947. Following that notation in Line 9 you will find a replacement. The replacement in that instance is a replacement of the equipment which has been added to the system. In other words, on Line 9, the figure 5 under the caption 1949, refers to the same five Chevrolet pick-ups shown under the caption 1947 on Line 8. The necessity for the purchase of five additional Chevrolet pick-ups in the year 1947 I believe has been very well substantiated by Mr. Strong in his evidence. This is additional equipment which the superintendent of the pipeline system has determined will become necessary by reason of the additional requirements of personnel, such as requiring automobiles for added patrol service, and other added features, concerning which Mr. Strong has testified. There will be an added foreman, I believe, in
764 District No. 3 and another in District 4 and another in
5 West; another pick-up will be necessary in 5 East and another in District 6. These are for general maintenance and added maintenance which will be necessary by that time. I concur, without qualification, in Mr. Strong's judgment.

These other items down to Line 12 have to do with replacements of existing equipment and are subject to the same explanation made with reference to Items 1 to 7, inclusive. Item 12 is a reflection of our required added maintenance costs by the addition of two International five ton trucks in 1943 and two in 1947. The same explanation which I have made with reference to the added equipment noted in Line 8 explains these requirements for added equipment. I have considered the subject of this added equipment in detail with Mr. Strong and I am in full accord with his judgment. Line 13 is subject to the same explanation as Line 9.

In the normal operation of truck equipment on the pipeline, it is necessary to furnish trucks with a semi-trailer or occasionally a complete four-wheel trailer for hauling pipe. When we buy an additional truck, it is necessary to supply the trailer that accompanies it. That item is set out in Line 15. The equipment there shown will be acquired in the year 1948. The reason for supplying the additional truck explains the necessity for the additional trailer and we have arrived at the necessity for this additional equipment in consultation with Mr. Strong in the

same manner as stated with reference to equipment already discussed.

Line 17 reflects the replacement of ten light tractors now in use on our system. These tractors are used in emergency work and for rather heavy maintenance, requiring the service of a winch somewhat more substantial than that which we have on our trucks. There are nine of these tractors on the pipeline properties and one on the Texoma properties.

Tractors are used for erosion control where we have to move a lot of dirt. We have in the field what are termed tumble bugs accompanying these tractors for moving the dirt; that is, they scoop up about a yard of dirt at a time and haul it and dump it in another location to refill, dams and things of that character. We have a definite policy with reference to trading in and replacing this type of equipment, as in the case of automobiles, trucks and trailers. That equipment will be replaced as indicated on Line 17, three in 1945, three in 1946, and three in 1947. In addition to the uses already mentioned, these trucks are used quite extensively in emergency repair work. We depend on the tractor for getting over the ground that the truck could not get around on at all. We have had some experience with that. All of these tractors have proven invaluable in an emergency of that character, particularly where it is wet and soggy.

On Line 18 is shown a R-4 tractor. This is a little heavier type of equipment than No. 22, noted in Line 17. We know from our experience with these light tractors that we can justify a heavier tractor for some of the work which they are doing, and that is reflected in the additional equipment on Line 18.

765 Our analysis and study of the future requirements discloses that we will require additional Caterpillar tractor equipment in the years 1943 and 1947. We know definitely we are going to have a heavier maintenance program. We believe that the use of the tractor equipment will facilitate the use of trucking equipment to an economical degree. We can justify a tractor over a truck in many heavier items of maintenance. It is our purpose to add larger tractors at the time we make these additional purchases. The same situation is reflected in Lines 19, 20 and 21, and the same explanation applies to these items. These few items of additional equipment set forth here have all been carefully considered and studied with the operating

head, Mr. Strong, and I concur in the latter's judgment as to the necessity for these items. In fact, I go further than that. We have had requests already from the field for this heavier type of equipment. It is being delayed on account of heavier maintenance. In other words, I am already convinced that it will have to be provided but feel justified in deferring it.

There is no additional equipment contemplated for the compressor station department. It has one car now stationed at each one of these plants and we believe that it is sufficient for all time. This program contemplates the replacement of that car at such time as the mileage and condition of the car indicates that it is due for replacement. This is in line with our fixed policy.

Under the telephone department, there are three lines, "Chevrolet Coupe, Additional and Replacement". In this department, we are replacing the equipment in line with our established policy. An additional car is required in that department largely due to the fair wage and hour law. This is a department which only has six active field men and we are already experiencing some difficulty in getting emergency work done because of the forty-four hour week limit. I know that we will have to give this department an additional man next year when our weekly limit will become forty-two hours of work. Line 26 shows the replacement of that additional car which is noted in Line 25.

The telephone cars are subject to a great deal more mileage service than some of the other cars. These boys put mileage on their cars that averages, I would say, about twenty-five hundred miles a month, and it is not unusual to find it up to three thousand miles a month. I believe that is the explanation for not having a replacement in 1941, having a replacement in 1942 and in 1943 of that car, skipping a year and replacing it, skipping it another year and replacing it, replacing it in 1948 and 1949 and having two replacements in 1950, 1952 and 1953. It is due to the factor of mileage as well as time entering into the future use of these cars.

Questions by the Examiner.

The description of the automobiles set up in Items 4 and 5 is not stated in detail. I have the description by passenger cars. We have in operation ninety-one units on both companies. Of these there are forty-three light pas-

senger cars, Chevrolet sedans and coupes. We have eighteen Chevrolet pick-ups, thirteen trucks, seven large passenger cars, ten tractors and, I believe, ten trailers, a trailer not being considered as a power unit. There might be twelve trailers.

766 *Direct Examination by Mr. Morgan.*

Page 3 is quite comparable to page 2 in its explanation, that page applying to the equipment of Texoma Natural Gas Company. The items noted in here are the replacements and additions with respect to the cars on the gathering system and the pipeline. Page 4 is a continuation of page 3 by departments. The third page covers the gathering system and pipeline requirements and page 4 the production department, telephone department, compressor station, and gasoline plant.

Those additional units to be acquired in the future for Texoma have been determined in the same manner as have the additional units already referred to. I have consulted with the department heads working with me concerning the additions to and replacements of all department cars except those of the production department, and on these requirements I have consulted with Mr. Dickinson. I am in accord with these department heads as to the additional units that will be required by Texoma. These replacements will be made in pursuance of our already established policy as to replacements. As already stated, the summation of those pages is shown on page 1. Going back to the second subhead on page 1, the term "Book Cost of Property Retired" indicates the original cost of the equipment, which we are retiring from plant in the two properties. We have used the basis of cost of the automotive equipment referred to in this exhibit the price prevailing as of June 1, 1939.

Under the caption "Salvage Value", Lines 7, 8 and 9, on page 1 of the exhibit, is reflected the trade-in allowance which we have been able to obtain in replacing our equipment on both properties, and also for the combined system. The trade-in values used are those obtaining as of June 1, 1939.

We establish the figures for the trade-in value by reflecting what we have been able to obtain from the equipment traded in. We have been able to get considerably higher trade-in values than those indicated in the automobile industry's blue book. This is due, I believe, to the fact

that we have found the economical point for trading in our equipment. There is a compromise between mileage and the age of the car, and we are getting the maximum economical benefit from the use of any piece of equipment and the maximum trade-in allowance when we replace it. General Motors have told us that we are operating our fleet as economically as any fleet operator that they are acquainted with.

There is one thing that I might add in explanation here. If you will follow through you will notice that cars are being replaced on Texoma's system more often than they are by Natural Gas Pipeline Company. That is largely a reflection of the condition under which the cars are operated in the Panhandle field where we lack good roads. There are some roads, of course, but most of the travel is done over that part of the field where we depend on pasture roads, with very few bridges, and it is necessary to gun the cars in crossing creeks. In fact, I have not been able to get the salvage values from cars traded in for Texoma that we have those traded in for Natural Gas Pipeline Company. We have had the experience of replacing motors entirely on account of the dust.

767 (EXHIBIT NO. 115 was then offered and received in evidence over the objection of counsel for both Commissions, for whom exceptions were noted at the direction of the Examiner. Motion to strike testimony also denied.)

Cross-Examination Interposed by Mr. Slaff.

Salvage value, as reflected in Exhibit No. 115, is based on our past experience on trade-in values. From trading in these cars we have had the experience of getting so many dollars in trading two or three cars. Now, we would expect to get the same trade-in value had we traded this car in on June 1, 1939. This is, in effect, the average of trade-in prices for the type of car under consideration.

Direct Examination by Mr. Morgan.

I have heard the testimony of Mr. Bussard, Mr. Kesinger and the various operating heads concerning the study that has been conducted over the past year and a half and more, concerning the future requirements for additional capital expenditures and capital expenditures to replace

existing equipment, and for maintenance and for operation. I have had considerable to do with these studies. I would like to review some of the facts that pertain to this forecast which has been made. This work started in February, 1938. Mr. Kesinger outlined a program to us for forecasting our future operation, maintenance and capital requirements. We attempted to carry this to completion, while continuing our regular operating duties, by calling in men from the field who were closely associated with the actual work to be done. It was apparent along about the first of the year that we were not getting the results that Mr. Kesinger expected, and it was decided to relieve these operating heads from their normal operating duties, and have them devote their time exclusively to this estimate. Since that time I have been consulting with these men and coordinating the work of one department with another. My opinion has been asked in many instances, and I think I am very well acquainted with this whole estimate so far as the operating departments are concerned. I could not devote as much time to it as I would have liked, because it was incumbent on me to keep this pipeline going. We still have to operate. In addition to my consultations with the operating heads, Mr. Strong, Mr. Powers, Mr. Bulla and Mr. W. H. Davidson, I have consulted with other men who I think are qualified to give an opinion on whether these costs are justified or not. In addition, I have gone to the field and have tried to get the independent judgments of the boys actually on the job in many of these forecasts. I worked with the department heads on occasion and on some of the detail itself. On some of the major matters I would like to think that I contributed something toward a more substantial figure than would have been obtained otherwise.

Now, I have done considerable estimating in my time, but I have never had the problem of forecasting an expenditure to the degree that Mr. Kesinger was insisting on in this budget. The exacting character of this forecast, as originally outlined to me, led me to believe that it was going to be the greatest job of crystal gazing that any engineer ever had. As this thing has turned out, I sincerely believe it is a conservative estimate, far from being a boiler-house guess. By a boiler-house guess is meant, in
the vernacular of the oil field, a rather violent
768 assumption. You might appreciate it if I tell you
that a pumper on a lease in the middle of the winter is inclined to stick pretty close to the boiler house, where

it is warm, and particularly if there is a lot of snow on the ground and a blizzard outside. He will open a crack of the boiler-house door and he will guess his production for the day, instead of going out and measuring it. Maybe you can sympathize with the boy, if he has to walk over a foot or a foot and a half of snow on an 80-acre lease; possibly he is justified in making a boiler-house guess then.

But this thing is far from being a boiler-house guess. It has received concurrence through a sifting process that has repeatedly gone on, with Mr. Kesinger's perusal of all of these factors. Mr. Brown has been in on it, too. I really believe there is nothing to qualify in the future costs that we have reflected in this estimate.

Now, there are many items of contingencies which have been eliminated in this sifting process which to my mind are justified in the actual estimate which we have prepared. I think in my own mind that many of these things which we have called contingencies are so probable that personally I would put them back in there. Walt Davidson has testified that he has a large number of cracked cylinders on his compressors. They are operating satisfactorily at this time, but we cannot tell when they are going to break. He has indicated that he is going to try to weld these cylinders. He has estimated that he is going to be successful in replacing half of them. I believe that is a speculation. This six-ton casting that we have got there is an intricate thing that is difficult to weld under any circumstance. There is no doubt in my mind that we are not going to be able to successfully weld half of these cylinders, and I believe that in an estimate of this character it is within the realm of probability to call for the complete replacement of these cylinders. Walt, however, has included the replacement of just one-half of these cylinders. I think that in providing for the replacement of half the present number of cylinders and for the welding and saving of the other half we have been too conservative, because the probability is that we will have to replace them all. It will cost more to replace them all than it would to weld half of them and replace the other half. The replacement of those cylinders is a major item of expense, which we have not included in our estimate at all.

I will tell you another instance where I personally think there is some reason to doubt the low cost that we have reflected here. We have initiated a program of installing booster stations. I believe the lay-out has been described

to you in sufficient detail. There was no such booster unit available when I had this idea of putting individual boosters on wells. The Cities Service Company had put a booster at a central point where they collected the gas from a large number of wells. Now, such a station as that will require attendant labor; it will require the maintenance of heavy equipment; it will require large horse power, because the intake of that station is dictated entirely by the delivery requirements of the lowest pressure well in that particular group. Now, contrast that with this idea that we are advancing here. We have developed this unit through the cooperation of the Cooper Com-
769 pany and have installed one of these boosters that has been running now since last October. We contemplate that these boosters which will be installed, with such safety devices as are capable of protecting the machine within a reasonable degree, will operate without attendant labor. It will not be necessary to develop any water supply for the station; the housing problem is eliminated; but there is a big speculation on whether that unit is going to work out successfully or not without this attendance. When we get ten of these units all strung out on a line and depend on automatic devices to shut them down if anything goes wrong, whether they will run continuously without attendant labor is something to speculate with. Now, if we find out that we have to go to such a station as the Cities Service Company have installed in that field, it will require at least twice the investment that we have allowed for these booster stations and twice the horsepower.

I could go on indefinitely, within reason, with any number of these contingencies that I believe should be contemplated in this budget, and for these reasons I believe that this cost that we have reflected, both in operation and in future capital cost, is the minimum. Now, there is one thing to bear in mind. When you compare this system with any other that is operating in the country, to my mind there is no degree of comparability at all. We have got something more than a hole in the ground from Texas to Chicago here. We have a line that is operating at high pressures. High pressures in themselves do not mean anything, if you have the steel to hold them. The reflection of the high pressure is only what may happen in the event of a rupture. The merit of this pipeline system, however, the very economy and the very reason which justified it is the fact that we work this steel at stresses far beyond those

on any pipeline that is in existence. When you are working this steel as we are, you just cannot take a chance on having anything happen.

Now, this factor of reliability is, I think, reflected in the load factors that we have carried. We could not have convinced these industries along our line and in Chicago that it was worth while hooking up to this natural gas supply, unless we had demonstrated that this reliability means something to them. The only way that we can get this reliability into the system is to keep forever after the trouble that we may anticipate, so there is a continual round of inspection, inspection of this and of that, just to establish that it is all right. The compressor station equipment is overhauled completely every year. I think I can say this, that I know it as a definite fact that there is no natural gas company in the country that goes to the extent that we do to insure the reliability of this service in the degree of overhauling compression equipment. The boys in the field right now are active on all of their erosion control on this pipeline, anticipating what may happen with snow, ice and what not this winter. The summary is that we are not taking any chances at all with any part of this equipment that we have. Our instructions are to keep it up to the highest degree of safety, not only for this reliability that I have indicated, but also for the safety of the personnel that operates it. In other words, eternal vigilance is the price of safety, if I may make a pun on a famous expression. (Motion by Commission Counsel to strike so much of witness' last answer that goes to any period beyond the immediate future denied.)

770 STANLEY GILL, recalled by defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 3, 1939.)

I have already stated my qualifications at the time I testified before. My first work in the Panhandle field was in connection with oil operations. I was employed by the Gulf Production Company; and from sometime in 1927 on I was more or less actively engaged in work in connection with oil operations, principally corrosion

studies related to the sulphur water produced in the oil areas and also certain evaporation studies and studies of corrosion or gathering lines; and studies on gas lift operation, which was apart from corresion. We were not much interested in gas. I was generally familiar at that time with the gas, but the gas did not amount to much in the beginning. The operation of the gas field was not of particular interest to the Gulf organization. That work continued until the end of 1931, at which time I started my consulting practice.

Since 1931 I have been engaged a considerable part of the time with some job or other relating to gas in the Panhandle, and have been in and out of the field intermittently over the period of years since January, 1932. My work since 1932 in the Panhandle has been concerned entirely with the gas operations, both in the sweet and sour gas areas. I am familiar with the producing conditions, existing pressure conditions, and the various problems that are incident to the drilling and operation of gas wells and the gathering of gas in the field.

You ask what part I had in making the engineering studies which have been brought into this proceeding through witnesses, namely, Mr. Kesinger, Mr. Bussard, Mr. Dickinson, Mr. Powers, Messrs. Davidson, L. E. Strong, Mr. Bulla, and others. My primary contact has been with the problems related to the study of field operations; that is, up to the time the gas goes into the compressors at Fritch. I have not had any particular contact with the detail of the estimates from that point on. My first contact with this particular job was, I believe, in January or February, 1938, at which time I was employed by Mr. Kesinger to advise with him and with Mr. Bussard and with Mr. Kuhne on the method to be employed in making forecasts of production development programs. Mr. Kuhne is a production engineer for Texoma Natural Gas Company at Amarillo. I don't remember the exact sequence of the thing. I think my first conference on that was in Chicago. I made two or three trips to Chicago, and several trips to Amarillo in this connection. Mr. Kuhne had made a more or less rough preliminary estimate, based on a study of back pressure curves, for Texoma wells; and employing an arithmetical averaging method for predicting future performance. I reviewed that work with him and with Mr.

Dickinson, and took the Texoma back pressure test data and used that and the Railroad Commission's rock pressure and open flow figures, over a period of two or three months, and developed a method based on weighted averages which I applied to the same problem. I developed a lot of calculations and certain generalized conclusions. I conferred with Mr. Kesinger, Mr. Bussard, and Mr. Dickinson on those methods, and sent numerous curves, calculated in various ways, to both Amarillo and Chicago; and sat in on conferences in Chicago and in Amarillo, in which the basis of the methods used by Mr. Bussard was discussed and decided on.

771 I am familiar with these back pressure curves that were presented here by Mr. Bussard in his Exhibits 89, 90 and 91, which were used in connection with his testimony. No. 91 is the back pressure extrapolation, and No. 90 is the map.

The application to wells of back pressure tests and the computing of curves from data contained in these back pressure tests are relatively new things. They have been applied ten years or so. There is nothing new, however about the principle. The principle on which the Bureau of Mines based the development of their tests is, of course, the same principle of computation of gas flows and pressure drops as has been used for a long time; and it is the principle of our formulae, such as the Weymouth formula, for the computation of flow of gas in pipes. The basic principle there is that the rate of flow of gas is a function of the difference between the square of the absolute inlet pressure and the square of the absolute exhaust pressure.

The Bureau of Mines' engineers recognized the need for a test method which would give the information that the industry needed from these test results; and working from the principle that the rate of flow would be the function of the difference in the squares of the absolute pressures, made a rather exhaustive series of well tests. They developed methods for computing the pressure at the sand face; and found by a study of their test results that in general the rate of flow of gas was a direct mathematical function of the difference between the square of the absolute formation pressure and the square of the pressure which existed at the bottom of the well against the sand face while the well was producing.

Having confirmed their hypothesis, that it would be a function of that difference in squares, they then presented their method; and all that these back pressure curves are, this straight line on logarithmic paper, is simply a graphical method of expressing that one thing, that the rate of flow is a function of the difference between the square of the formation pressure and the square of the pressure within the well at the face of the sand. Mathematically the formula is that the rate of gas flow is equal to a constant times the difference between some pressures raised to some power, which is "n". That is equivalent in saying in lay terms that there is a constant or definite relation between open flow of the well and the pressure for a given set of formation conditions.

Questions by the Examiner.

This is in substance exactly what is set forth in Monograph No. 7. I am not sure that it is all set forth in Monograph 7, or whether it is more fully covered in the early reports of the investigation; that is, in Reports 2929 and 2930. But what they did was to develop methods of calculation of pressure at the sand face, which were essential. They then studied their experimental data, working from the hypothesis that the rate of flow would turn out to be an explanation of the function of the difference in squares of the pressures, and found that it was true. The formula, of course is $Q = C (P_t^2 - P_s^2)^n$. That, of course, is the type of relationship which is expressed by a straight line on log-log plotting paper.

772 The industry needed a test which would give this additional information; and the Bureau of Mines provided a formula and method which gives the information that the industry needed. I do not remember whether the introductory paragraphs of either report 2929 or report 2930 or Monograph 7 indicate the object or purpose of the Bureau of Mines in making those reports. Those publications do point out uses which can be made of the method and the data which can be derived from those test results, which were not available under previous methods of testing. By what I have said I intended to state that this work of the Bureau of Mines supplied a need in the gas industry.

Direct Examination by Mr. Morgan Resumed.

There was a very definite need for a type of information which could not be secured by the then existing tests. This back pressure test method accomplishes essentially two things that were not accomplished prior to its introduction. The first is to give a substitute for the old method of determining the potential by measurement with the well flowing wide open. That has been referred to as the Pitot Tube method. The Pitot Tube method was a method of measuring gas flowing out of the well while it was flowing wide open. This method was wasteful and dangerous. It was recognized as a poor method for those reasons. The industry did not care so much about it being wasteful particularly, but they did not like it on account of the danger in it.

From the waste point of view, there are two common methods of running these back pressure tests. One is by the use of what is called the various critical flow pressures or orifice tester, which is a device which is described in Monograph 7. It is a small orifice which is put on the head of the well, and through which the well is allowed to produce against atmospheric pressure. By that means a certain amount of gas is wasted, but it is a small amount, since the production has to be taken through a small orifice. The test can be qually well conducted, and is very frequently conducted by using meters which are regularly installed on the wells, and by producing gas during the test period into the line. In that case the waste is entirely eliminated.

From the standpoint of dangers, the hazard of running potential tests is practically eliminated. In running open flow tests there is a fire hazard, because we have a well flowing a lot of gas into the open air; and my own thought is that the greatest hazard is the hazard of tearing out the bottom of the well, because I had a lot of work in a country where you can't flow wells wide open. They have loose sands, which will simply tear the bottom hole fittings all to pieces, and you simply cannot do it by using the open flow on those wells. In fact, the deterioration of open flow potentials was impossible prior to the development of this method.

The use of this back pressure method of making these tests results in additional information besides that dis-

closed by the Pitot Tube test. It does two things. The second to my mind is the most important. These back pressure test curves are frequently referred to as delivery capacity curves, rather than as back pressure test curves. That nomenclature, delivery capacity curves, indicates what is probably their greatest value as operating information. The curves can be applied, not only as they have been applied here, for the prediction of potentials at any future time when pressure has declined to an assumed value; but they also show directly how much gas a well in the condition in which it was at the time the test was made will deliver against any specified
773 back pressure. That is, we can take a gas well, and from the delivery capacity curve or back pressure test curve, we can see how much gas that well is capable of delivering into a line at 200 or 250 or 300 pounds line pressure. Now, that could not be determined at all from open flow tests; and that is the type of information which is invaluable in the operation of gas properties, which could not be obtained previously, prior to the development of this test method. I think the greatest use of the information that is gained from such tests is in determining the present flowing capacities of wells at any given or assumed back pressure. For example, if a well is being produced into a line, the working pressure of which is 200 pounds, you can take the back pressure curves, or the back pressure test information, rather, and determine how much gas that well will put into that line against that working pressure. That is the information that is of greatest value in its practical application.

I have examined the procedure which Mr. Bussard adopted in dividing the areas in which Texoma has wells and properties yet to be developed into groups—I believe thirteen groups—as reflected on Exhibit No. 90 now on the board before me. In the method of calculation and prediction that Mr. Bussard employed, that division into groups was really essential to the planning of the development, gathering and boosting program. The boosting program particularly could not have been developed on the basis of county averages, or anything of that sort. What he did was to divide the Texoma holdings into groups of wells in which the performance of the wells in a given group was comparable, and in which the geographic location of the wells in the group was

such as to enable him to plan the future program. There were advantages in using these groups as opposed to counties, from the standpoint of producing conditions because the wells in any group will have rather comparable performance. In other words, the probability is that a well drilled in any one of those group locations will conform in its performance more closely to the average performance of the wells in that particular limited area than it would do to the average of the performance of the wells spread over the entire field or over a county. In any group the pressures are comparatively uniform throughout. In any county that you could name in this field you will find pressures approximating original pressures and pressures that are very low. You will also find productive areas and areas of comparatively small productivity. This is reflected by Mr. Hughes' maps which were put in earlier here. We would also find the conditions as to inside and outside drainage from Texoma's leases entirely different and wide variations if you took it by counties. Some of these difficulties have been overcome by the breaking of this area in which Texoma owns producing properties and properties to be developed into groups as Bussard has done. I am in accord with the conclusion reached by Mr. Bussard that the average of the back pressure curves of wells to be drilled in those areas, together with the wells that have already been drilled in those areas, will approximate the average back pressure curves that he computed and that he shows on his Exhibit No. 89. I think that is the only sound and reasonable conclusion. I think Mr. Bussard has made an entirely sound and scientific application of good engineering principles in determining the potential producing capacity of wells to be drilled in the future at the pressures which would prevail at the time those wells were drilled. I agree with his methods.

774 The estimates of the future producing capacity of wells as indicated by these back pressure curves and as calculated by back pressure tests which form the basis of those curves is based on the assumption that the producing characteristics of the wells will remain unchanged over future years. Now, as a practical operating proposition in the field, they won't, and the productivity of the wells in the future as a practical matter will be lower than the productivity that is predicted by this strictly scientific method.

I think the method employed by Mr. Bussard in computing the number of wells that will be required to meet the market outlets of Texoma on a basis of back pressure curves as he has stated he used those curves in those computations is scientifically correct; but I do not think that the number of wells that that scientific calculation calls for will, down the years, produce as much gas as those calculations say they will. We know as a matter of fact that the back pressure curve of a given well does not stay the same over a period of years, that due to effects which act to reduce the effective permeability of the formation surrounding the well bore the back pressure curves tend to shift to the left. In other words, the productivity some years from now will be less for a given pressure difference than would be predicted from a test made today. Now, the effects that serve to bring that about are, in general, effects which reduce the permeability of the formation immediately surrounding the well bore. Those effects are, so far as we know, occasioned principally by two things: One of them is simply the effect of the velocity of the gas moving into the hole, and the second more important class of effects is that related to water, both salt water from the bottom or from above, and fresh water, which is condensed out of the gas as the pressure is reduced in the movement of the gas into the well bore.

Salt water will produce various effects, of which one is the clogging of the capillary pores by liquid water. Some of the pore space, through which this gas can move, is shut off unless room is left for it to come around. Or salt water from above trickling down over the face of the well bore is evaporated by the gas leaving a deposit of solids—that is, salting up,—which also clogs the formation. Water in the formation, and particularly fresh water which is contained in the gas and which tends to condense out of the gas as pressure and temperature are reduced, causes the formations, and more particularly shale, to flake and powder, and this broken formation, if it is dropped out back from the well bore clogs the pores and reduces the permeability of the formations.

Shale and other formation matter from up the hole also falls back down into the hole, either dislodged by the gas stream or loosened by water condensing out of the gas stream, falling down to the bottom of the hole, and has to be cleaned out periodically by blowing or other methods. But some part of that over a long period of time appar-

ently stays stuck to the walls of the hole and clogs the pores still more.

Salt water which comes in laterally through the producing formations will take up a certain amount of pore space, just fill up a certain number of pores through which gas is moving now, and just won't give gas a chance to get into them.

775 Salting up is more a matter of salt water trickling down from above and leaving a deposit of solid salt on the face of the well bore. This formation of salt operates to reduce the productivity of the well or the producing capacity of the well by closing up or reducing the pores or channnels through which the gas flows.

As a practical matter, there is no way to counteract those influences that happen in the producing formation. We know that the productivity of wells decreases with time. All of those factors act to decrease the productivity. Now, theoretically there might be a change where some of the formation on the walls of the hole down at the bottom might come loose and fall in and open up a little bit more pore space, but as a practical matter, as far as I know, if it does happen at all it is over-balanced by these other things, because the actual effect is the reduction of productivity with time. I know of no data on the basis of which such correction can be made through which we can ascertain how much this interruption or interference with the predicted open flow indicated by scientific calculation in conjunction with the application of the back pressure test principle. I think the proper scientific procedure is to take conditions as they exist today and calculate your prediction on the basis of those conditions. If the data were available, correction could be made, but there is no way to be sure of just how much that shift will amount to.

Mr. Bussard recognizes that it is going to take more wells than his study indicates to supply the quantity of gas which will be required by these pipelines. It is no criticism of Mr. Bussard to observe that more wells will be required and that it is going to cost more to get that gas than Mr. Bussard's figures indicate. The drilling of additional wells would increase costs all up and down the line. There would have to be additional meter settings, more gathering lines, more men to operate those gathering systems, to change charts on those meters, more people to calculate the charts. Then it will also require more booster horsepower, not because of any changed total quantity of

gas, because the quantity of gas would be the same, but because these wells at the reduced delivery capacity will have to be opened up wider to produce the same quantity of gas That will mean lower working pressure and, consequently, greater booster horsepower in order to ram the gas into the main gathering line. I have heard Mr. Dickinson's testimony concerning what he termed the orderly distribution of this drilling over the years instead of waiting until it was a physical necessity to have the production. He assigned two major reasons why that was done. One was to minimize the cost and to keep the supervision of this drilling under the eye of the trained personnel, which could not be accomplished if the wells were all drilled, or a comparatively large number of them were drilled, over a short period of time. The other reason he assigned was that from an engineering standpoint it was desirable to postpone as long as possible the production of these wells up to the limit of twenty-five per cent allowed under the Texas statute. I think Mr. Dickinson is entirely correct in this last observation. As a matter of general practice, it is bad to operate a gas well at too high a percentage of its open flow. Twenty-five per cent is the established statutory limit in Texas, as in many other gas producing states. That is an absolute limit, and is a much higher percentage of open flow than is best for good well performance. All of
776 the troubles that occur in gas well operation are accentuated as you operate at progressively greater percentages of the open flow rate. You just have a great deal more difficulty and expense in keeping the wells in good operating condition.

Referring to Mr. Dickinson's testimony that Texoma has operated its wells at a rate of less than ten per cent of open flow throughout the history of that company, in my judgment, it is a very good practice. It reduces the amount of work that is necessary to keep the wells operating and the cost of keeping the wells in operation. It operates to postpone the time when these complications about which I have testified as occurring in the bottom of the wells will overtake the operator. Take, for example, the problems that result from condensation of water out of the gas in the hole. When a well is operated at a lesser percentage of its open flow the drop in pressure and temperature as the gas moves into the hole is much less than when it is operated at high percentages and, therefore, there is much less condensation of moisture in the hole. The same is true

of velocity. Essentially the velocity of the gas through the formation is a function of the percentage of open flow, because maybe one well will have an open flow of fifty million and another well will have an open flow of ten million. The velocity in the formation is not five times as much on the fifty million well as it is on the ten million well. It is pretty much the same. That difference of potential means principally that the fifty million well just has about five times as much open passage for delivering gas to the hole. That difference then between those two wells does not make any difference practically in the formation velocity, but if you operate either of those wells at twenty per cent of its own open flow capacity, you will have about twice as high a formation velocity as if you operate that same well at about ten per cent of its own open flow, and that increaseed velocity has an increased tendency, of course, to break down the formation.

I am familiar with the charts contained in Exhibit No. 91. I have gone over and examined the method employed by Mr. Bussard of extrapolating the course of the weighted average pressure curves of the respective groups set forth on Exhibit No. 90 and continued over to Exhibit No. 91. I think that is a reasonable basis of extrapolation of the possible method of predicting the future course of rock pressures in these groups. It is the method which, first, seems to be most in accord with the performance of the wells up to the present time and, second, it is the method which leads to an indication of the best future well performance; that is, it is the basis of extrapolation that indicates Texoma will require the least number of wells in the future. By that I mean this: On these pressure curves you have certain fixed data. First take this Figure 8 that is curved for group 8 on Exhibit 91. You have the data on past performance of the weighted average rock pressures of the wells in the group. That runs from 1935 to 1938. That gives you as basic data the course of the actual decline of rock pressures for a period of years. The other fixed point is fixed by the basic estimates of reserves. Mr. Peterson's estimates ha been used by Mr. Bussard in preparing those curves, and the predicated rate of withdrawals from the field as a whole is from the estimate which I believe Mr. Dickinson presented here. He did a great deal of work in connection with it. That gives you then another datum of pressure and time at the end of this

extrapolation, so that the extrapolation consists of
777 getting from the 1938 point to the terminal point, which is 1954, with twenty-five pounds per square inch gauge pressure at the wellhead.

Now, there are three ways the extrapolation could run. It could run from this 1935 to 1938 curve, running convex upwards, or the 1938 point could be connected to the 1954 point by a straight line, or the extrapolation could be made concave upward. It is apparent from both of these groups, both Group 1 and Group 8, that the extrapolation in the form that has been made, convex upwards, runs along reasonably in accord with the course that the pressures have taken so far. From point of view that looks like the most reasonable means of connecting these fixed points. This form of extrapolation of a curve convex upwards, which of course means that the pressures will fall off at a lower rate in the beginning than they do towards the end, is also in accord with reasonable expectation of what will happen in the Panhandle field as a follow-up to what has happened. That is, as has been mentioned before, the heavy withdrawals up to the present time have been from those parts of the field in which the reserves were greatest. Now, later on in the life of the field there will be more and more development and withdrawal out in areas which are now the higher pressure areas and those withdrawals from those higher pressure areas will bring about an accelerated decline in average pressures.

We have already gone pretty thoroughly into the reason for this. It is a matter of the size of the container in relation to the withdrawal. The circumstances that many of the high pressure areas are of low productivity, or what is called lean areas, will involve the future behavior of pressures. Withdrawals of the kind that have occurred could not have taken place if the reserves had been equal. I mean, if you step out into the higher pressure areas and move your withdrawals into the higher pressure areas you will get a higher average decline. Looking at the picture from the standpoint of potentials or the producing capacity of Texoma's wells in the future and taking the course of that curve as interpreted by Mr. Bussard, and comparing that course with a straight line or a line which has a concave curve upward, either a straight line or, to a greater extent, a curve concave upward would indicate that the pressure at any point between the 1938 pressures and the terminal pressures, which are the same for each of the

three, would be lower than the pressures which are indicated in the form of extrapolation used. At any point of time between 1938 and 1954 on the other forms of extra-polation would indicate a lower pressure. Take, for example, this Group 8, and say for 1945 the form of extrapolation used indicates a pressure of slightly over 300 pounds per square inch, a straight line would indicate a pressure below 250 pounds. Now, taking those two lines for the time being, the curve used by Bussard, which indicates an average pressure for group of 300 pounds per square inch, would indicate a higher producing capacity for Texoma's wells as of 1945 than would a straight line which indicates a pressure of less than 250 pounds per square inch. This is due to the circumstance, of course, that the relation between the potential and the pressure remains constant, using those average composite curves. And since the pressure is lower, following it down the straight line, the potentiality or producing aggregate of Texoma's wells at any given time will follow that pressure down in the same relationship and will indicate a lower available potential for Texoma.

778 Applying that principle to the drilling program of Texoma, the use of a straight line extrapolation would call for a considerably heavier drilling program than does the use of the extrapolation which was employed. The conception or interpretation of Mr. Bussard of the course of that line operates to convince him that there will be a fewer number of wells required than would be the case if that line went down on a straight line from its position on January 1, 1939, to its position at the end of 1954. (Motion by Commission Counsel to strike the testimony of Mr. Bussard with respect to results which would have been achieved or might be expected through the use of other line projections denied.)

If the decline of pressures was strictly proportional to withdrawals, in other words, in any field to which the pressure decline method can be properly applied for the estimation of reserves, a straight line extrapolation would be proper. That is, where there is the condition of equal withdrawals ratably over the field to reserves in place, so the pressure decline is uniform all over the field, and where the condition of every acre in the field is such that it originally had the same reserve as every other acre, then a straight line extrapolation and a straight line de-

cline of pressures are experienced. That is not the situation in the Panhandle, and I do not believe that this curve will take the course of a straight line from where it is found on January 1, 1939, to the point which it will reach at the end of 1954.

Questions by the Examiner.

The charts in Exhibit 91 represent a function of Boyle's law, as modified by the sub-surface conditions. What I have just pointed out are conditions that would affect the operation of Boyle's law one way or the other. Under the strict application of Boyle's law, these declines would have a straight line relationship.

Direct Examination by Mr. Morgan (Resumed).

I am familiar with the terms "liners", "tubing" and "clean-out tools", mentioned by Mr. Dickinson in his testimony, in which connection he stated that it will be necessary to install liners on some of Texoma's wells, that in other wells and in perhaps some of the same wells it will be necessary to install tubing and that it will be necessary for the company to equip itself with clean-out tools and equipment going with clean-out tools, for the purpose of keeping those wells in reasonably good producing condition. Basically, the function of a liner in a gas well is to let the gas through and hold the formation back to keep cavings from coming into the hole. Looking over Mr. Dickinson's estimates I got the general impression that he probably did not provide for enough liners. I think the need for liners is going to be the rule rather than the exception, especially in the set up of Texoma's wells. Most of the wells will require liners, especially later on in their life when the pressure gets down to the point where you cannot blow them clean so well and when water conditions in the formation are causing more and more cavings.

The use of tubing is to facilitate the operation of blowing the wells clean of water, cavings and scale which fall into the well bore. By the use of tubing you are able to clean the wells by blowing more readily, and thus avoid cleanout jobs with tools. It is not particularly necessary in the early life of a gas field or a gas well to use tubing,

because the well produces a large enough quantity of
779 gas so that when you open it up through the big pipe you get a velocity of gas flow sufficient to carry this foreign matter out of the hole. Later, as the wells decline in productivity, the volume of gas produced when the wells are opened up is not sufficient to give a velocity sufficient to carry the heavier materials out of the hole. By installing tubing and by blowing through a small tube string, instead of through large casing, the velocity of flow with the same volume of gas being produced is greatly increased; that is, approximately, comparing an 8-inch casing with a 2-inch tubing, the velocity for the same total volume of gas will be sixteen times as great in the two-inch tube, so it will carry out this stuff when it will not carry it by flowing through the 8-inch casing. Thus, by putting in tubing when it gets so that you can't blow the well satisfactorily by blowing through casing, you are able to clean in later life and thus reduce the number of clean-out jobs with tools which are necessary.

Mr. Dickinson testified that in his judgment it would be necessary to install tubing in two hundred and four wells out of the total of three hundred and fifty wells. If I were guessing at it, from what I know of the field, I would guess three hundred and fifty. I think it probably will be necessary to install tubes in all of them. I think that is somewhat of a guess. I think Mr. Dickinson probably made his estimate based on a detailed study on each individual well. I base this on what I might term a broad gauge estimate, though it is not one of those boiler house estimates that Mr. Dickinson was talking about. I have been guilty of boiler house estimates, as everybody else has around the oil field, but this is not a boiler house estimate. It is probable more wells will have to be tubed than Mr. Dickinson has estimated.

As to clean-out tools in the declining years of a gas field, I have never yet seen a gas field where you did not need them. They are essential. Mr. Dickinson has provided for two strings of clean-out tools and the essential equipment for use in the clean-out operations on Texoma's wells, numbering one hundred and thirty-five on January 1, 1939, plus those which have been added since January 1, 1939, and the wells to be drilled, at the rate of approximately twenty a year for the next several years. I think Mr. Dickinson is pretty optimistic. I don't think that one string of clean-out tools will take care of one hundred and

thirty-five wells. In general, I would say under conditions such as those in the Panhandle that barring accidents that will occur on an occasional job, it would keep one clean-out rig humping to keep up with a hundred wells. It is doubtful if one clean-out rig can keep up with more than seventy-five or eighty wells satisfactorily. That would call for four or five strings of tools.

Speaking of the personnel employed by these pipelines and the policy of the companies in furnishing housing facilities for their regular employees, I am familiar with that policy and have seen some of their camps. I have heard of their other camps but have not seen the compressor camps up the line. I have visited the camps at Fritch, Kingsmill and I seem to have a recollection of having seen their camp at Dumas. In the latter camp there are only one or two houses. It has been my experience and observation that it is not an unusual procedure on the part of pipelines to furnish their field personnel with housing facilities. It is practically the universal practice in all field activities of oil and gas companies everywhere. I do not mean in the Panhandle only but you will find this practice wherever there are oil or gas fields. It is the usual thing among pipelines, 780 gasoline plants, or field refinery operations. I don't know just where this policy or practice started. There are a number of reasons for it. For one reason, you just can't keep the men you want unless you have those facilities. It is such a thoroughly recognized custom in the field that men want to live on the job. That is fine from the standpoint of the employer, because it is highly desirable, and in the case of some operations, absolutely essential to have the key men housed close to the job. That is necessary and desirable principally for the emergency phase. There should be men who know the job, and who are capable of handling an emergency, on the job almost instantly in case anything should come up. It also makes the day by day operation that much easier. The men are closer to work. They get there on time, regardless of weather or road conditions. Road conditions are more often than not awfully tough around these operations. In the Panhandle it is pretty bad. The roads are bad and there is a lot of bad weather. I have gone out in the morning in the middle of a big sand storm, and come back in the afternoon through mud, heavy rain, and sleet freezing when it hit my windshield, sliding all over the road. That

is an area of high altitude and is subject to very severe weather conditions. Extreme and very sudden changes in weather occur. Also, in the Panhandle field as a whole, there are very few spots where a high class man would care to raise a family at all—in the towns outside of the company camps. To illustrate that, take the town of Borger. This town grew up thirty or thirty-five miles from a railroad to a town of thirty or thirty-five thousand people, in the middle of a big oil boom. It was a boom town of the worst sort. Every place that you ever heard of was rampant in the town, and I think still is. It is a dump I should say. It is a very undesirable place. There are no decent residences. There are shacks, and a few fairly nice business buildings, and more that are far from being decent. Here is what happens in a situation of that sort. The Phillips Petroleum Company have a big refinery which is just a mile or two from Borger, and so far as I know none of the employees of the Phillips Company live in Borger. The Phillips Company have a camp which is practically a city. It is a city, it is a separate town called Wittenberg. It is completely a Phillips town. There is a school, elaborate recreational facilities; and so far as I know none of their employees live in Borger.

781 G. M. DAVIDSON, recalled by defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 3, 1939.)

I have prepared a list in compliance with the Examiner's request that I give him a break-down of the number of automotive units by classification and by name. It should be cross-referred to page 2 for Natural Gas Pipeline Company and pages 3 and 4 for Texoma Natural Gas Company. This list of equipment includes the following: For the Natural Gas Pipeline Company there are ten International trucks with trailers; thirteen Chevrolet pick-ups; twelve Chevrolet coupes; sixteen Chevrolet sedans; and there are nine No. 22 Caterpillar tractors; and four heavy passenger cars, a total of sixty-four units. Referring to Texoma Natural Gas Company, there are three International trucks; five Chevrolet pick-ups; eleven

Chevrolet coupes; four Chevrolet sedans; one No. 22 tractor; and three heavy passenger cars, a total of twenty-seven units.

This morning in a hasty glance at page 2, pertaining to Natural Gas Pipeline Company, I failed to notice, it being rather difficult to read across these lines, that there was an additional car for the telephone department to be purchased in 1947, making two additional cars, noted on Line 25. Now, the question I think also was brought out as to why we replaced a car in 1942 and 1943. I think this can be explained by considering the car's life as being twenty months. Then if you were to buy it early in 1942 you would replace it by the end of 1943. There is the required stretch of twenty months in there. It is rather complicated to clear it up when it becomes two cars purchased at different intervals in there. It is just a matter of following our fixed policy of replacing these cars at regular intervals, rather than running them until they are ready to fall to pieces.

782 P. McDONALD BIDDISON, a witness for defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 3, 1939.)

My name is P. McDonald Biddison. I live in Dallas, Texas, where I have resided since the fall of 1931. I am a consulting engineer, specializing in natural gas and petroleum work.

I graduated from Kansas State College in 1904 with the degree of Bachelor of Science in electrical engineering. After about one year of work at Iola, Kansas, as a draftsman, electrician, instrument man, and stationary engineer, and a few months at Ziegler, Illinois, as an electrician, I began to do engineering work in the natural gas industry at Columbus, Ohio, in 1905. I was employed first as a draftsman on plans for work for the Kansas Natural Gas Company under the chief engineer of the Logan Natural Gas and Fuel Company, who was the consulting engineer for the Kansas Natural Gas Company. I later succeeded him as chief engineer for the Logan Natural Gas and Fuel Company.

In 1907 I went to Joplin, Missouri, with the Hope Engineering and Supply Company, and was engaged upon designs for natural gas properties proposed to be constructed. Late in that year I moved to Independence, Kansas, as assistant to the chief engineer of the Kansas Natural Gas Company, and was engaged in supervision of construction and in the design of compressor stations and pipelines.

In the fall of 1908 I went with the Columbia Gas and Electric Company as construction engineer, and built for them a compressor station at Kenova, West Virginia, and supervised the construction of the western end of their 20-inch line into Cincinnati.

Following this I was employed for one year as construction engineer by the Ohio Fuel Supply Company in Ohio. That system is now a part of the Columbia Gas and Electric properties.

Following this I was employed for a year as construction engineer by the Texas Company at their Port Arthur works on the installation of the steam generating equipment, electrical generating equipment, and water supply for the refinery, and as consultant on the design of concrete building foundations.

In 1912 I again became associated with the Ohio Fuel Supply Company as construction engineer, and remained with them until the spring of 1919. My duties were design and construction of the gas engine driven compressor stations, measuring and regulating stations, distribution systems, pipe lines and shop buildings. While I was employed by the Ohio Fuel and Supply Company I also acted for a four-year period as consulting engineer to the Lone Star Gas Company in Texas. I designed for them and supervised the construction of compressor stations at Petrolia, Texas, a gasoline plant at Petrolia, Texas, and laid out their programs of additions to lines and station capacity. I predicted for them each year for a four
783 year period the number of wells required to be drilled to maintain their gas supply.

During the time that I was with the Ohio Fuel and Supply Company I also conducted research upon the extraction of gasoline from natural gas in cooperation with the United States Bureau of Mines; and for a period of about three years I had supervision of gasoline production for the Ohio Fuel Oil Company in West Virginia.

During the period of the War I also acted as consulting engineer to the United States Bureau of Mines on war gases, and supervised the helium production program to the point where helium plants at Fort Worth were ready to begin operations.

In the spring of 1919 I went to Mexico and was there for two years on the construction of oil pipe lines and oil loading facilities; the first year I was with Atlantic Gulf and West Indies Steamship interests, and the next year I was with Tide-Mex Company, a subsidiary of the Tidewater Oil Company.

Returning from Mexico in 1921, I became associated with the interests who owned the Dallas Gas Company and some producing properties in north Louisiana. I acted as consulting engineer to the Dallas Gas Company and to the County Gas Company, an affiliate. I supervised the development of production and the marketing of production from the Louisiana fields. During this period I constructed some pipe lines, some distribution systems, made gas sales contracts, and reported upon pipe line projects to such markets as there were available to lines out of the Monroe field area; some of which lines were subsequently built, and one of which I started construction on, but sold the properties before construction was completed. Upon the sale of these producing properties, I remained with the properties for about one year and participated in negotiations leading to the construction of pipe lines to New Orleans, to Memphis, and to St. Louis, as an engineer for one of the parties in interest in those lines, and supervised the construction of the pipe line from New Orleans to Baton Rouge.

In the fall of 1928 I severed my connection and opened an office in Monroe, Louisiana, for the practice of consulting engineering. During that fall I reported to the financiers upon the project for a natural gas line into Salt Lake City, which was constructed, and made a valuation of the property of the Lone Star Gas Company's distribution plant at Fort Worth. Following this I became associated about the first of January, 1929 with the Southern Natural Gas Corporation; for which I acted as consulting engineer during the construction of their pipe line system extending from the Louisiana gas fields across Mississippi and Alabama into Georgia, and down past Mobile, Alabama, into Pensacola, Florida. Upon completion of their con-

struction work and the substantial completion of their sales contract arrangements, I severed my connection and moved to Dallas, Texas, where I have been located since, engaged in consulting work. I have been very largely connected with valuations of natural gas properties and with testimony before courts and commissions with regard to values of that class of properties.

784 I have knowledge concerning the properties of Texoma Natural Gas Company and Natural Gas Pipeline Company of America. This knowledge I acquired by making two inspections of the properties of these two companies. The first inspection was made in March, 1938 and the second in May, 1939. The purpose of these inspections was to determine the condition of that property, to familiarize myself with the methods of construction used, the methods of maintenance used, the degree of care used in maintaining the property, the degree of safety maintained in the companies' operations, and the degree of safety of their installations. I have in process of preparation a study dealing with the condition of the pipe line, which is to be introduced later in connection with the reproduction valuation.

I was asked in connection with my employment to observe the personnel and to make a confidential report on the personnel to the management. I have made such report.

On both of these inspections I began at the field on the system which is the property of Texoma Natural Gas Company. I inspected down there wells, well measuring stations, pipe lines, and telephone lines, to determine their condition. The inspection of pipe lines was accomplished by having sections of pipe line exposed by digging a bell hole. A bell hole is simply a hole big enough to get down in and see and work around a joint of pipe. The bell holes which we requested to be dug on this property for that purpose provided for approximately six feet or more of length of the pipe to be exposed, of which four feet was to be cleaned of any protective coating or rust or scale. They were large enough so that the pipe was exposed for its full circumference so that the entire body of the pipe could be seen and inspected. The clearance under the pipe was sufficient that one could get down under the pipe and look up at it. The clearance on the sides was ample to permit free access to the pipe all around. Since the

pipe is of varying size in the field lines, of course the holes were of varying sizes. For the first inspection the intervals at which these bell holes were opened were approximately five-mile intervals over the pipe line and over the gathering system. When I went back to inspect it a little over a year later those bell holes had been filled up, but on the second inspection they opened new bell holes to the number of about half as many as those opened on the first inspection. Taking the two inspections together, an aggregate average of about three holes was opened for each ten miles of pipe line. This obtained throughout the main line and the gathering system.

I inspected and examined the field facilities, the wellheads, the various plant equipment, as well as the personnel out in the field. I saw their automotive equipment, their tools, their clean-out equipment, and looked at their installation of stream crossings to see what their condition was and what the prospects were of their maintaining those stream beds in the status quo. I inspected the residences and warehouses at Dumas and Kingsmill. I inspected Fritch station, including the compressor station and the agsoline plant and the dehydration equipment, the residences and the warehouses there. Proceeding up over the main line I inspected pipe at locations as I have previously outlined, looked at gate boxes, and as I came up on to the property of the Natural Gas Pipeline Company of America I stopped at each compressor station and noted the condition of the various classes of equip-
785 ment in each compressor station, of the automotive equipment which was available on locations to be seen. I inspected the telephone line. I made notes as to the amount of hours of operation of engines. I examined their records of engine repairs, became acquainted with their scheme of maintenance and with the personnel in charge of operation at various stations. My inspection also included their housing facilities. I ascertained the stresses at which the pipe and the equipment on this pipe line were operated, the load factor, and other kindred features of information. I have gone over that data and made calculations from the operating pressures and the character of pipe as to what the stress in the pipe walls was and as to the degree of safety of operations.

This pipe line is not operated along the same lines as other lines from the standpoint of pressure conditions and

stress conditions. It is something far in advance, from the standpoint of technical engineering, from the standpoint of economy, and the use of steel, of anything that has heretofore ever been constructed or even conceived.

Instead of basing the safe operating pressure or the factor of safety upon the ultimate strength of the steel, as has been the common practice in the design of pipe lines and of pressure vessels in general, this pipe line has had its operating pressure fixed by a ratio of operating stress in the pipe walls to the yield point of the metal, and in selecting the materials to be used the engineers who built this pipe line secured production on a large scale of steel for pipe line purposes having a relatively high yield point compared to steels previously used for such purposes. The net result was that they secured pipe which could be used for pressures very much higher than ordinarily had been used previously on pipe of this size and of the wall thickness used. The result is that they have secured a capacity per pound of steel far above anything previously obtained.

The use of these higher pressures and the use of higher stresses in the pipe walls means that on this pipe line failures must be foreseen and avoided by taking precautions in advance of their failure, otherwise serious interruptions to service will occur, and otherwise the employees and the public in the areas traversed by the lines will be subjected to risk of loss of property and of life. There is a difference in the result of the parting of a pipe line or the explosion of a compressor or of some equipment through which gas passes at the high pressures used by these pipe lines, and the result of such occurrences in the case of a pipe line utilizing pressures up to three or four hundred pounds. With the pressures at which this line is operated, the pressure being something like twice that commonly used on pipe line transmissions, the damage that would be done would be twice as much as ordinarily, by virtue of the difference in pressure.

Now, this is a large line, a 24-inch pipe line, and upon rupture the amount of energy which would be suddenly released from a line of this size and at the pressures existing would be in the order of five or six times more than that on a 16-inch line at 350 to 375 pounds. So the amount of damage that could be done by a rupture on this line

would be many times that which you would expect from the usual sized pipe line at the usual pressures.

786 I have seen a number of pipe line ruptures. A pipe line rupturing at high pressures will generally throw a joint or two joints of pipe out of the ditch and will hurl it a hundred yards or more, and the escaping gas will scour out in a few minutes a hole that you can set a big truck down in. A line rupture on these properties would scour out a hole that you could get a good sized dwelling in. If a fire does not occur the area damaged would ordinarily not be so great, but the chances for fire and explosion on one of these line ruptures are generally quite high, because sparks generated by pebbles hitting upon steel may set off an explosion, under which conditions a very large area may be damaged and structures somewhat adjacent to the right of way may be damaged or destroyed. If a fire of that sort occurred at a compressor station with these high pressures, there might be an extremely high loss of property, accompanied by serious injuries and loss of life.

I have conferred with most of the men who have testified in the last few days in regard to the probable capital and maintenance requirements of these pipe lines and their operating expense over the next ten or twelve or fifteen years. I refer to the studies conducted directly under the leadership of Mr. Bussard, concerning which I have heard other witnesses testify. I have conferred with them while they were preparing the data and studied the data as they were preparing it. I am familiar with the exhibits which they have prepared and which have been introduced in evidence in connection with their testimony, particularly the exhibits of Mr. Powers, Mr. Davidson and Mr. Strong.

In my trips over the properties of Texoma Natural Gas Company I saw a stream called the Big Blue in Moore County, Texas at several points. The reason I happened to see it at more than one point is that Texoma has pipe lines crossing this stream at I think three points, and I crossed it at other points besides those locations where the pipe line crossed it. I have heard the testimony of Mr. Strong concerning the item shown on page 3 of Exhibit 105 which refers to a bridge across the Big Blue River to be erected in or prior to 1942, at a cost of $54,508.

The bed of that stream has shifting sand bars and the

banks are eroding away, and changes in the banks could be detected between the inspection I made in the spring of 1939 and the one I made in the spring of 1938. I think a suspension bridge is the only way in which they can secure a permanent installation across that stream any place near the point to which Mr. Strong testifies that a suspension bridge will be erected. The revetment work and bank protection work which Texoma has done and is doing, while it retards erosion of the bank and retards the shifting of sand bars, does not and cannot prevent it. I think this improvement should be made at an early date because Texoma is dependent upon the use of the line which crosses that stream at that point for a large portion of its gas supply and to maintain continuous service that line must be kept in continuous operation. It is my judgment that about one more flood on Big Blue Creek down there will see that bridge go in in a hurry.

The next item on that page is "Two 12-Inch Lines Across the Canadian River." That stream, like prac-
787 tically all streams in that general area, has a wide bed, with shifting sand bars and a channel which may be at one bank for a while and after a flood shift to the opposite bank. These shifts cause the movement of acres, hundreds of acres of sand in those river beds. Since a large portion of the gas supply of Texoma Natural Gas Company must cross the Canadian River through this line, it is essential, for the continuity of service, that they have lines installed across this stream bed in sufficient amount that if, upon some of those shifts of the sand bed, lines are washed out, they will have enough remaining lines to maintain operations close to full schedule. In my judgment it is a necessary engineering step to provide additional pipe line capacity at the Canadian River crossing. The only question in my mind is whether they have provided all that they would be justified in providing. They could quite readily justify providing more lines. That stream is notable for its treachery and has been as far back as the history of that territory runs. It is almost impossible to enumerate the railroad bridges, the pipeline crossings and the ordinary highway bridges that have gone down that stream. Under dry conditions it is possible to walk across that stream. Under flood conditions it just takes everything in front of it.

Another item shown on page 5 is the replacement of

river headers. I am familiar with the river headers up and down this pipe line. My judgment is that these headers should be replaced. These headers were of good design at the time they were built. They were probably the best design that could have been obtained at that time. Since then other methods of construction have become available, which enable now a design which will avoid some of the weaknesses of these headers, and it is just good judgment and good engineering to eliminate the chance for fracture in these old headers of the gusset type construction and replace them with something which is amply safe for the working conditions to which they are subjected.

The same situation and observation applies to drips. There have been improvements in the design of drips presenting an exactly parallel case to that of the headers. The headers are subjected to the greater stress, but the drips are subjected to more action from corrosion because they collect moisture.

Another important item included in Mr. Strong's program for improvements is the installing of welding sleeves at stream and gully crossings to give rigidity to the line at those crossings. These welding sleeves are not installed in lieu of the existing couplings, but are a reinforcement to the couplings. When the sleeves have been installed over the couplings, the couplings no longer have any function to perform. They can be installed in this fashion without shutting down the line. This procedure adds strength and safety to the pipe line at the coupling and is a cheap form of insurance against difficulty at those minor stream and gully crossings. These sleeves are a little thicker than the pipe and are composed of the same type of metal.

On the same page there is another item on line 6 for the laying of six new pipe lines at the Canadian River. That is the same river but not the same crossing about which I testified a little while ago. The crossing referred to on page 5 of the exhibit is the crossing of the 24-inch main line leading from Fritch up to Station No. 2. The same conditions exist at this point on the Canadian River crossing as exist on the 24-inch line leading to Moore County and there are additional reasons for providing
788 stability at this point over those pertaining to the 24-inch Moore County line, in that this line carries all

the gas which leaves Fritch station for the Chicago area. It is on the main line and if that crossing is out the whole system is out.

Passing to page 8, I note an item of 15,600 feet of 12-inch line at the Arkansas River, at a time not later than 1943. I saw this crossing upon both inspections. The river at this point has a wide flange, subject to overflow, and the river crossing there should be extended back safely out of the overflow territory. The banks on this stream, at the location of the crossing, are caving and it has shifting sand bars. I think this work should be done, and I think, further, that if between now and 1943 there is another bad flood on the river, the work proposed there will be done prior to the date for which it has been estimated.

On the same page is an item which occurs in several places in Mr. Strong's exhibit, that is, the installation of cathodic protection. That has something to do with electricity and corrosion as a result of the electricity, and is an electric method for the mitigation of corrosion. I think it highly desirable to install cathodic protection for this pipe line. There are locations along this line where the protective coating has been penetrated and where corrosion has begun. A line constructed as this line has been, with a high grade of protective coating, is the type to which cathodic protection can be economically applied. If some means be not taken to check corrosion, large percentages of pipe will become pitted, to the extent that replacement will be necessary. The installation of units for cathodic protection at the proper points along the line, where the indications are that corrosion will become severe, will very materially curtail the rate at which pipe will need to be removed and replaced in this system. It is the cheapest form of protection that can be obtained for pipelines of this character. It has not been necessary in the past to install this protection because the coating has functioned, except in the instances referred to, but there are already a few locations at which the protective coating has begun to show failure. There will be more of them.

There is also quite an item on page 8 entitled "Install Two 16-Inch Lines, Beaver River." Beaver River is in a wide valley. About three years or so ago, during a severe flood, it just simply went wild, changed its course in some loca-

tions as much as a mile, took out some stream crossings of some other pipeline companies, and is apt to do the same again. The crossing of this system's line on the south side has headers up fairly close to the south bank of the river. The river crossing lines, when I inspected them in the spring, had had some work done on them, but a new channel was working upstream toward those lines. That was in the spring of 1939. Some additional protection against interruption at this stream is necessary, and this is an economical method of achieving that result.

On page 9 of the same exhibit there is provision for installing river clamps and reinforcement straps at the Republican River.

The Republican River is in a wide valley and the stream flow at one time was confined to a narrow portion of the valley by good levees, but severe floods a few years ago took out large portions of those levees, and they have not been replaced. The result is that there are large diameter lines in a valley that is subject to overflow, and any
789 large diameter lines that are apt to become submerged must be stiffened up at the joints to prevent rupture of the joints and must be weighted down to prevent their floating out. In my judgment this is a necessary precaution.

On page 10 are references to various types of replacements at river crossings, namely, Walnut Creek, Nodaway River, South River, Box Elder Creek, Squaw Creek and other creeks. I have seen most of these crossings but don't think I have seen every one of them. For the replacement work on these streams I think that it is a wise precaution to keep those wide diameter lines across these comparatively small streams well down below stream bottom. I think it is essential to do that. I think, further, that since corrosion does generally take place at the approaches to streams, it is advisable, on a line of this size, where the amount of gas that can be packed into the line to take care of interruptions is small compared with the market demands, that stream crossings should be investigated and relaid at periodic intervals to insure continuity of service. I have seen Walnut Creek, Middle Nodaway and Squaw Creek, but I am not sure whether or not I saw the others, although I am definite about those I have named. What I have said here applies to any of the streams of that character across which this pipeline runs. At periodic intervals these crossings should be reworked, and the way to re-

work them, since you must maintain service, is not to repair the old, but to take the old out and lay new line.

Mr. Strong, in his Exhibit 105 and in his testimony concerning that exhibit, has made provision for future replacements of approximately six per cent of the pipe line on the main system and three per cent on the gathering system. We have no history of a pipe line with the kind of protection which has been used on this line, covering a period long enough to give any conclusive data as to the reasonableness of that estimate of pipe replacement. The estimates which have been made as to the amount of pipe to be replaced on this system are based upon the expectation that the protective coating will, in large measure, continue to afford protection in the future as it has for the eight or nine years of past life. If the company is disappointed in that, then the amount of pipe replacement which will be required will be several times this six per cent for the main transmission lines and three per cent for the gathering lines. Pipe replacement will then begin to approach that experienced by other companies, because when this protective coating is gone, then this pipe is subject to the same effects of soil conditions as would be a pipe which had been protected with something inferior to begin with, and from that time on the pitting rate will be the same as if it were bare pipe. Then, unless this coating continues to function as Mr. Strong in his study has assumed it will, my view is that his estimates are far below the actual replacements that will be required. Assuming that this coating does continue to function as Mr. Strong assumed in making up these figures, I think his estimates are reasonable. They are conservative. I think he has allowed for this purpose less than will be required, rather than more, as the future will develop. (Motion to strike above testimony denied.)

In the testimony of W. H. Davidson and in his Exhibit 97, provision is made for future investments for the renewal of red wood cooling towers in Stations 2 to 10, inclusive, and Mr. Powers testified to a similar replacement necessity in connection with the cooling towers at the Fritch station. I am certain these installations will be required

790 because these towers are wooden structures, bolted together. They are high, and they are subject to shaking and to being stressed by wind and snow loads. While red wood itself is a material of long life, yet the joints in the structures become loosened and weakened, and the

method of repairing those conditions is to take them down and put up new ones. It is inevitable that they will be replaced. I think the time he has set out in this exhibit is a reasonable expectation as to the period in which that will be done. I have seen work in progress at several of the stations, repair work, and from my knowledge of structures of that sort I know that they have to be repaired and work must be done on them practically every year.

Referring to another item, shown in line 24 at page 2 of W. H. Davidson's exhibit, providing for the construction and equipping of a central machine shop for heavy machining in connection with the operations of the compressor stations, I think this item is essential. They have ten compressor stations. As these engines grow older, and in the near immediate future, the amount of work required to be done to maintain them in operation is going to show a substantial increase. The repair work to be done requires equipment that is not found in very many machine shops. To get the work done expeditiously, economically and properly, they need a shop of their own of that sort. Other concerns have found it necessary, and I would think that they should certainly have one by the time predicted, if not before.

Pipe lines generally provide these facilities because of the necessity of having their work done when the occasion arises to do it. If the repair of machinery is needed to get an engine into operation tomorrow or the next day, having some machine shop available to do it a week from some Thursday will not help you out much.

The commercial type of machine shop is not designed for this particular class of work. There may be some railway shops that would be equipped with machines for handling railway locomotives, and some manufacturing shops with equipment designed for the manufacture of their particular product; but no shops that I know of have the equipment designed for handling the specific character of material that this company has. Ordinarily, machine shops are not found in a county seat town, and even if they exist, my experience has been, when I was with the Ohio Fuel Supply Company, that we needed a shop of our own, and we built one practically right in the middle of a manufacturing district, in the town where some of our engines were manufactured. This was done for reasons of economy and for reasons of continuity of operation. By

that I mean the saving of time to get a part which goes out of commission back into service.

Without referring to any other particular items shown in the exhibits introduced in connection with the testimony of the three witnesses, Strong, W. H. Davidson, and Powers, I have made a careful study of the schedules of additions to plant, replacement of plant equipment and maintenance, as well as operating charges, set forth in these exhibits and concerning which they have testified. In my judgment the sum of money set forth in these schedules of additions to plant, replacement of plant equipment, and the items of maintenance and operating costs are reasonable, and in the future course of events will actually be expended by these pipe lines in connection with their operation. I think in the preparation of those schedules that allowances have
791 been made for various expenditures which could be foreseen; but I do know that there are many contingencies arising that can't be foreseen and that some of these contingencies entail the expenditure of tremendous sums of money, and that no allowance has been made for that in the preparation of these exhibits. It is my judgment that the companies should have an allowance for contingencies above the amounts which they have estimated, because they estimated only the items which they could definitely foresee. This allowance for unforeseen contingencies should be not less than ten per cent of the maintenance and of additional capital items. (Motion by Commission Counsel and Counsel for Illinois Commerce Commission to strike testimony of Mr. Biddison denied.)

Cross-Examination by Mr. Slaff.

I have never prepared a list of cases in which I testified since going into private practice, but since 1928 I have testified in the Federal court at Fort Worth in the case of the Lone Star Gas Company involving their Fort Worth distribution properties. I have testified before the Railroad Commission of Texas in a number of cases involving both distribution systems and the gate rate for the Lone Star group of properties. I have testified before the Railroad Commission of Texas in the Laredo distribution case. I have testified in the State District Court at Austin, Texas, in the case of the United System, involving the Laredo rate, and in the case of the Lone Star Gas Company involving their gate rate; and in the case of the Interna-

tional Gas Company involving the Wichita Falls rate. I have testified before the New Mexico Commission in regard to the Albuquerque Natural Gas Company. That was a case involving the application of the state law as to pipe lines being common carriers. I testified before an examiner for the Federal Court of the Western District of Arkansas in the case of the Arkansas-Louisiana Gas Company involving the Texarkana, Arkansas, rates, and again in a case for them involving the proposed municipal pipe line for Texarkana, Texas. I testified in the Federal Court in a case with respect to the Community Natural Gas Company's rate for gas involving Royse City, Texas.

Of the cases in which I testified before the Texas Railroad Commission involving distribution plants, there were Wichita Falls, Denton, Sherman, Waco, Fort Worth, and Greenville, Texas, and a dozen or more similar communities which have had cases up before that Commission. I testified before the Oklahoma Commission in a case involving rates at Sapulpa, Oklahoma, in a case involving rates for Avant, Oklahoma, and in cases involving the distribution rates in twenty-six towns of the Community Natural Gas Company, an affiliate of the Lone Star Gas Company. That was in Oklahoma. I testified in the State District Court at Austin in a case involving the Public Service Corporation of Texas, as to their transmission properties and as to distribution properties in Perryton and Canadian. I testified in the District Court at Waco in three cases for Texas Cities Gas Company involving damages as a result of explosion and fire.

I will prepare a list of the cases which I have given to the reporter, as well as any others that I may find in my files, together with a list of the dates of my testimony. This will have to wait, however, until I am back in my office and have access to the information. I will have this information available at the next hearing at which I am present.

792 I was a joint author with Burrell and Overhold of Bulletin No. 120 of the U. S. Bureau of Mines on the extraction of gasoline from natural gas by the absorption process. I believe that was in 1916. About the same time, the same data essentially was presented as a paper before the Natural Gas Association of America. Then I had a paper before a joint meeting of the American Society of Mechanical Engineers and the Natural Gas Division of the American Gas Association at Shreveport about 1930 on some of the economic phases of pipe line design. I had a

paper before the Natural Gas Division of the American Gas Association at Dallas about 1927 on limiting factors for pipe line projects. I had a paper at the Memphis meeting, about 1931, of the Natural Gas Division of the American Gas Association on some of the economics of pipe line design, and I have had some later technical publications of one sort or another. I had a paper at the last meeting of the Natural Gas Division of the American Gas Association at Tulsa this year on the subject of "Fair Rate and Fair Return." The paper I presented at the Dallas meeting dealt with the cost of construction of natural gas pipe lines. This was about the year 1928. Two or three of the gas journals reprinted this paper.

793 R. M. BUSSARD, recalled by defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 4, 1939.)

When on the stand before, I testified that certain of the detailed studies concerning future costs for additions to plant, replacements of plant equipment, and maintenance and operation would be presented by the various department heads and that other of these figures would be presented by me. I have prepared exhibits showing the future expenditures not accounted for in the various exhibits brought in here by the department heads who have testified.

(At this point counsel handed to the reporter a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company; General Expense, Taxes, New Business Expense; R. M. Bussard—Witness", with the request that it be marked for identification as an exhibit. At the direction of the Examiner the reporter marked such document Exhibit 116 for identification.)

I have Exhibit 116 for identification before me. This exhibit relates to the general expense, the taxes, and the new business expense of defendants. There is a detailed sheet on each one of the items for each of the companies, and a combined sheet for the three items I mentioned.

Page 1 of the exhibit relates to the new business expense of the Natural Gas Pipeline Company of America. Page 2 is a summary of taxes to be paid by the two companies, showing a column for each company and a total for the

two companies. Both of these pages show the sums already paid out in that same connection down to and through the year 1938. The details of the figures summarized on page 2 for Texoma are shown on page 3, which covers that company's taxes from the years 1932 to 1954, inclusive. The same detail is shown on page 4 for Natural Gas Pipeline Company of America over the same period. On page 5 appears a summary of the general expense of the two companies, and the total or combined general expense. The supporting detail for Texoma is shown on page 6 of the exhibit and for the Pipeline Company on page 7 of the exhibit.

Going back to page 1 of the exhibit, the figures opposite the years 1932 to 1938 are the amounts of expenditures for new business that were incurred by the company during the years named and are taken from the books of the Natural Gas Pipeline Company of America. The figures opposite the years 1939 to 1954, inclusive, are our estimates of the future costs of this activity of the Pipeline Company. This department was originally named the new business division but its duties have been extended to include other activities. They merely maintained the name that it was given at the beginning. The estimates for the year 1939 are based upon the amounts of expenditure incurred to date, plus our estimate of the amount that will be incurred during the balance of the year. This estimate of the amount that will be incurred during the remainder of the year is based solely upon the amounts of payroll now being incurred by that department. That is the present payroll 794 at the current rates, with a slight allowance for miscellaneous materials and supplies used by the department. This is the normal allowance for such items. The advance in the first column as between the years 1938 and 1939 comes about by a non-recurring item of expense which was paid in 1939. The reduction which is shown in the second column between the years 1938 and 1939 results from an adjustment of salary expense for a part-time employee of that department. The figures projected from 1940 forward are based on the present status of that payroll.

The explanation of the circumstance that in the second column no amount is set out for the years 1952, '53 and '54 is that we do not expect to have sufficient gas to meet the full market requirements of the companies during those years. Inasmuch as this part-time employee is concerned with the marketing activities of the company, we felt that

we would not be justified in continuing his cost through the years of declining sales volume and, therefore, we have eliminated that particular item of expense in the years named. In other words, the business will be getting less at the point when we are no longer in position to have gas with which to load our lines, and his services will no longer be required.

Turning to page 2, which is a summary of the taxes, and the detailed breakdown of the different taxes to which these companies are subjected, I point out that these taxes are based upon the present tax liabilities or present statutes levying taxes of the various kinds to which these companies are subjected, as applied to the personnel, the property, and the volume of gas to be produced and sold by the company as set forth in the studies which have already been introduced at this hearing. We have made no provision for any increase in the rates of taxes or any increase of levies of taxes, but have adjusted the computations to meet the existing statutes governing the levying of taxes.

Texoma Natural Gas Company is now subject to seven types of direct taxes, namely, ad valorem taxes, franchise taxes, gross receipts tax, unemployment tax (both federal and state), capital stock tax, old age benefit tax, and income taxes (both state and federal). The two items, seven and eight, are not projected in the future for the reason that the federal gasoline production tax is no longer in force, and the automobile license tax was simply an accounting matter in the year 1932. This latter cost is now reflected in the departmental expense rather than in the tax expense. It is a tax incident to the operation of the automotive facilities.

Texoma's item of franchise taxes relates primarily to a tax imposed by the State of Texas. In the years 1932 to 1937, inclusive, the company paid a very nominal tax on the basis that the principal amount of its business was interstate, and hence not applicable to the Texas tax. But the State of Texas now is engaged in litigation with some corporations relating to the amount of franchise taxes which these corporations are paying. As a consequence, we paid a higher franchise tax in the year 1938, taking into consideration some of the points raised by the State.
795 The fact that the tax declined after 1938 is principally a reflection of the shifting between the gas and gasoline revenues, inasmuch as these revenues have an effect upon the franchise tax. If the State of Texas succeeds in its

litigation, our franchise tax will be materially increased above the amount of $1,663.90 set forth in the schedule. They will also claim back taxes for those years when the nominal amounts of $93.50, $71.00, and so on, were paid. The $1200 in 1939 and thereafter is the company's interpretation of its liability. That amount is less than the State claims we should pay. On page 3 the caption "Total 1939-1954" should read "Average". This is a typographical error.

There is one tax to which Texoma is subject and to which Natural Gas Pipeline Company is not subject. That is the tax set out in Line 3 and is a production tax levied by the State of Texas, based on the value of the gas at the wellhead.

Questions by the Examiner.

The history of Item 9 on page 3 and the reason why that item starts up in 1940 and terminates in 1946 is as follows:

When we take into consideration the estimated income of the Texoma Company and the deductions which will be allowed under the existing income tax law, we find that Texoma is subject to an income tax, and then we apply the rate in the existing law to the amount of the taxable income. Texoma is a non-profit corporation. (Company Counsel made the following statement: Its business is to produce gas and deliver it to Natural Gas Pipeline Company at cost. Cost includes all expenditures, including bond retirements from year to year. The reason the tax is payable in those years and not other years is due to the rate at which the bond retirements are to be stepped up in the year 1940. All of the bonds will be retired by the end of 1946 according to the present maturities.)

Direct Examination by Mr. Morgan Resumed.

On page 4 of this exhibit I have enumerated the different taxes to which Natural Gas Pipeline Company is subject or has been subject, and have shown the amounts of taxes that have been paid down to and through the year 1938, just as I did in the case of Texoma on page 3 of the exhibit. These taxes have been projected for the years 1939 to 1954, inclusive, on the basis of the existing tax laws.

The Natural Gas Pipeline Company is subject to nine types of taxes at this time, if we distinguish excess profits

from federal income tax. In other words, there are nine types if we say there is one type of tax which is called income tax and another type of tax which is called excess profits tax. Actually, they are both income taxes. Texoma does not have a pipeline permit tax, such as is shown on Line 3 of page 4. Texoma has not been paying any use taxes, as shown on Line 5. It is subject to such a tax in the State of Oklahoma, but has not had to pay any tax because its purchases for use in the State have not been sufficient to create a tax. The State of Oklahoma permits a $100 per month exemption.

On Line 8 is shown an item "Mortgage Registration". That had to do with the registration of a mortgage in the past and is not recurring. That is true also of the automobile licenses and miscellaneous taxes, which are subject to the same explanation as that made in the case of the same items heretofore paid by Texoma. The item shown in Line 11 as "Excise Profits Tax" is not projected for the reason that we do not anticipate that Natural Gas Pipeline Company will pay any excess profits tax in the future. The undistributed profits tax shown in Line 12 is no longer effective.

796 *Cross-Examination Interposed by Mr. Slaff.*

The federal and state income tax shown for Natural Gas Pipeline Company on page 4 is the result of estimated income less the allowable deductions under the existing revenue acts. The remaining income, which is called "Net Taxable Income", has been multiplied by the tax rate in the present federal revenue act, and also by the average rate that we have been paying in the various states. The explanation for the increase in 1947 and for five years thereafter of the federal and state income tax to about double what it is annually in the period 1939 through 1946 is in line with my explanation for the Texoma Company, where we show no income tax after 1946. This particular item of bond retirement under the contract between the two companies enters into the gas bill paid by the Pipeline Company, and when repayment to Texoma for that expense is no longer included in the gas bill, there will be no further expense imposed on the Pipeline Company for that item; hence, the taxable income will have an increase commensurate with the decrease in the expense, resulting in the increased tax after applying the effective rates.

Direct Examination by Mr. Morgan Resumed.

The total tax liability for the period 1932 to 1954, inclusive, aggregates $31,861,859.44 for the two companies.

The general expenses shown on page 5 are those overhead expenses of the company in connection with the operation of the Chicago office. They cover the payroll in the Chicago office, the rent, the materials and the supplies, traveling expense, telephone expense, telegraph expense, and other items that we incur in our Chicago office operations. The general direction of both companies is handled from the Chicago office. No part of the expense of the Amarillo office is included here. That expense is in addition to that of the Chicago office. In general, Natural Gas Pipeline Company of America pays all of the costs of the Chicago office, and then, while there are some expenses which it stands alone, the bulk of the expenditure is prorated partially to the Texoma Natural Gas Company. Twenty per cent of the expenditure is prorated to the Texoma Natural Gas Company. That determination was made before I had anything to do with it. I do not know why it was done that way. It was made by the management or by executive direction. When I made the estimate of expenses for these two companies, I simply took the accounting procedure that was in effect. I do not know why that percentage was chosen.

The first column of figures on page 5 has to do with the general expense which has been assigned and will be assigned to Texoma Natural Gas Company. The second column has to do with the expense which has been assigned and will be assigned to the Natural Gas Pipeline Company of America. The third column is the total.

The salaries projected in the first three classifications of general expense shown on page 6 are based upon the now existing amount of payroll costs without giving any reflection to any increase in wages or salaries to the individual man, and without reflecting any increase in the number of personnel in the Chicago office staff. It merely provides for the same personnel now employed in the Chicago office at the same salaries, and makes no provisions for increases.

797 The item "Office Supplies and Expense" is projected at slightly higher than the 1936-1938 average, but I note that there has been a steady increase in that item of expense through this three-year period. We feel that $1,450

is a very nominal allowance for this expense, particularly when we take into consideration the many additional reports which we have to make now but did not have to make a number of years ago. The unemployment tax, the old-age benefits tax, and other such items, have caused us a considerably increased amount of clerical work, and necessarily then we have to provide stationery, pencils, and other supplies for that type of work, and the stationery and printing, which is Line 5, is made up of that same type of expense and will require at least as much expenditure as we have made in the past three years. As a matter of fact, it has been projected at $23 less than the average for the last three years.

The item of "Legal Expense" may be divided into three parts. I will call the first part the company payroll. The company payroll part has been projected at exactly the level that now exists, without reflecting any increase in the payroll rate of the existing personnel and without including any additional personnel on the legal staff. As between the years 1938 and 1939 there is a difference in the number employed in the legal department. An additional man has been employed in the legal department in 1939 as compared to 1938, and that has been reflected in our estimate of payroll costs. The second part of the legal expense is created by the payment of the retainer fees of outside legal talent, and we have included in our estimated expenses the normal amount that we pay to this outside counsel. This refers to litigation in Texas and other states where the company is doing business. When I say normal, I have in mind the amounts that are reflected on the books of the Texoma Company, and I have studied the past payments that have been reflected on Texoma's books. The items of litigation are not the only legal costs incurred by Texoma. I meant that this item covers any character of legal service that is not performed by the legal staff of attorneys. The third item of expense under this caption is miscellaneous, for the various loose-leaf services, and other items which the legal department finds necessary in its business. This is in addition to law books, which are not included in the item of "Legal Expense." That voids any duplication with this office expenditure and equipment that we had the other day.

The item "Injuries and Damages" shown in Line 7 is just another way of saying workmen's compensation insurance required by the several states, and we have projected

the particular item of expense under the existing law without reflecting any increase in the rate. The fact that the item increases from year to year is solely due to the fact that there is an increasing amount of payroll expense from year to year as more men are needed. The rates at which compensation insurance is procured depend upon the payroll directly, and the latter is an important element in the amount of workmen's compensation insurance which we have to procure.

The item of "Insurance" is classified in two parts, roughly; the insurance which relates to the property and the insurance that relates to the payroll. We have projected our payroll rates and our property rates upon the basis of the existing statutes relating to these particular insurance items. We have had to show some increase in expense because we have some additional property which will be constructed in the future, and we also have additional payroll as we hire employees to take care of this additional property. My reference to statutes means
798 the statutes in Texas and to that type of insurance the rates for which are affected. Rates for ordinary fire insurance, and insurance of that type, are fixed by contract. In this estimate the contract rates projected are those which prevail at the present time.

The item "Rent" shown in column 9 refers to the lease between the Natural Gas Pipeline Company and the operators of the building in which the company offices in Chicago are located. The costs shown here are exactly in conformity to the existing lease and do not reflect any increases above the rates stipulated in this lease. They do not provide for any additional expense, and the space which we have to provide from time to time for certain matters, such as we are now providing for the Commission, and the expense thereof, is not included in this item of rent.

The item "Miscellaneous" is more or less of a catch-all account, in that the expenses which are not readily allocated to other accounts are included in "Miscellaneous". Our projection of miscellaneous expense is slightly higher than the 1936-1938 average, but I would call your attention to the fact that we have incurred practically $7,000 of expense each year within this three-year period which we used as an average. That is a rather indefinite class of expenditure. I have no specific way of determining the exact amount. It has been materially higher than $7,000 and has been somewhat lower than that amount.

The item "Traveling" covers the expense accounts of the executive staff and the clerical staff and the engineering staff when they are out of the Chicago office on the company's business. We have projected this expense at a few dollars less than the 1936-1938 average.

Going to the next item, "Telephone and Telegraph" covers the expenses we incur in connection with the services provided by the Western Union Telegraph and similar service. We project this expense at $15 a month more than the three-year average. This projection is less than the 1936 expense and a little more than the 1938 expense.

Drafting expense is incurred in connection with maps and plats and charts, and other items. I have shown an estimated cost of $10 more than the three-year average. This last item is increased by $10, which is a very nominal allowance and it would provide for very little paper or a very small tool that we might have to have in that time in that activity. I have no specific reason for thinking there will be an increase in expense.

The auto expense covers the cars assigned to the executive staff and has been projected at only $6 above the three-year average.

"Engineering and Research" is an item which is quite erratic and occurs from time to time, but we have projected it at only $8 in excess of the three-year average.

The item "Employees' Retirement Plan" relates to what is in effect a contract between the company and its employees. There is a life insurance company, which handles the funds accumulated under the contract. This contract between the company and the employees provides for pensions for these employees, and we have reflected the cost here in accordance with the provisions of the pension plan.

799 The increase between 1938 and 1939 comes about due to the fact that the plan was put in effect late in the year 1938. Therefore, 1939 is the first full year of cost on this item. The decrease in this item as we go from 1941 through 1942 and 1943 comes about because of the operation of the contract, under which by 1943 the company no longer has any obligation to pay to the insurance company any sums representing the cost of insurance covering past service as of the time the contract went into effect. All of these charges are in conformity with the contract.

Questions by the Examiner.

In Item 12, "Telephone and Telegraph", there is no Western Union lease mixed in that item. The lease expense in relation to Western Union is not in the general expense account of Telephone and Telegraph. My understanding of that particular item about which you ask is that it is located in the telephone department expense. There is no duplication involved there.

Among the various types of insurance which the company carries is a type called group insurance, which is a life insurance and a disability insurance, and the rates in the insurance contract are applied to the payroll of the company.

Direct Examination by Mr. Morgan Resumed.

Page 7 of the exhibit relates to the general expense of the Natural Gas Pipeline Company and is, in effect, the same kind of a page as page 6, relating to the Texoma Company. We followed the same procedure in determining the amounts shown along the respective lines on page 7 as we followed in determining the amounts shown on page 6.

(Thereupon EXHIBIT 116 was offered and received in evidence over the objection of counsel for complainant and the Commission who at the same time moved to strike this exhibit and all exhibits of a similar character, and the witness' testimony in connection with such exhibits. The objection and motion were overruled and the counsels for both Commissions were granted exceptions.)

Going back to Exhibit 116, there is no duplication between the item of "Legal Expense" as shown on line 6 on pages 6 and 7, and that shown in the exhibit offered through Mr. Campbell concerning regulatory expense. The legal expense, outside of the regular staff, connected with this case is not included in line 6 on pages 6 and 7 of Exhibit 116. This expense is included in the regulatory expense.

I have prepared a consolidation of the amounts to be expended, as determined by the economic study which others and I have conducted concerning the future operations of these two companies, which have been offered in evidence by the various witnesses here during these hearings.

(At this point counsel for defendants handed the reporter a document captioned "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Summary of Additional Capital Expenditures and Operation and Maintenance", with a request that the Examiner cause it to be marked as an exhibit. Thereupon, at the direction of the Examiner, the document was marked Exhibit 117 for identification.)

800 Exhibit 117 shows the consolidated figures to which I referred in my testimony a moment ago. The exhibit is divided into two general parts, one relating to the capital expenditures and items incident thereto and the other part relating to the question and maintenance of the companies.

On page 1 of the exhibit we find the consolidation of the capital expenditures, the book cost of the property retired, and the salvage items of the combined companies. At the bottom of this page there is the word "Note" and following that an asterisk, after which the language "Includes 1938 carry-over as follows," and then some details. The explanation of this note is that certain construction work which had been started in 1938 was not complete as of the first of 1939, or the charges therefor had not come onto the books at that time. The work was finished during 1939, and the cost of completing the work was called the 1938 carry-over, which is a term which we use to indicate the fact that the work was incomplete as of the first of the year.

The department heads were requested to omit from their estimates any work incomplete as of January 1, 1939. Their estimates covered only work that was commenced on or after the first of January, 1939. In order to give a complete picture of the property requirements of the two companies, it was necessary that we bring in the expenditures made during 1939 for those items which were in progress at the beginning of the year; such items not being in operating department statement. The amounts shown here have come from the books of the company and are not estimates.

Page 2 of the exhibit is a summary of the capital expenditures of the Natural Gas Pipeline Company. The expenditures are shown by years from 1939 to 1954, inclusive, and are shown by the several operating departments of the company, and also by the automotive and furniture and fixture items. The first column is captioned "Exhibit No." and underneath that caption are the figures 97, 105, 112, 115, and 113. These figures refer to the ex-

hibits that were offered by the various department heads, and they are placed here as a matter of identification. We thought this would assist anyone in understanding from whence came these figures. They occur through successive pages of the exhibit, and the same explanation is applicable to that caption and the figures underlying it wherever it occurs in the exhibit.

Page 3 of the exhibit is a summary of the book cost of property retired incident to the construction work of the Pipeline Company. The information is given by years and also by departments.

Page 4 of the exhibit is a summary of the items called salvage, which are accomplished in connection with the additional capital expenditures referred to previously. This sheet relates to the Natural Gas Pipeline Company. The figures are shown by years and by departments.

Sheet 5 of the exhibit is a summary of the capital expenditures of Texoma Natural Gas Company, and here again we have shown the figures by years and by departments. We consider the automotive and furniture and fixture items just as if they were departments within themselves.

801 Page 6 of the exhibit is a summary of the book cost of the Texoma property retired in connection with its additional capital expenditures. The figures are shown by years and by departments.

Sheet 7 relates to salvage incident to additional capital expenditures of Texoma, which we show by years and by departments.

Page 8 of this exhibit is a combined statement of the Natural Gas Pipeline Company and the Texoma Natural Gas Company, and is a summary of the operation and maintenance expenses which have been presented in several exhibits offered by the various operating heads, with the exception of one item. That one item is gas purchased from Colorado Interstate Gas Company. That is the first line of figures across the top of Page 8. These figures cover the cost of gas purchased by Natural Gas Pipeline Company from Colorado Interstate Gas Company, constituting one-fourth of the pipeline's requirements. The figures underlying the caption "1932" and successively through the year 1938 show the amounts of expenditure actually made during those years, and are taken from the books of the company. The figures underneath the captions "1939," "1940," and so on through the year 1954 relate to the costs which

will be met in the future for the purchase of gas from Colorado Interstate. The rates are those now in effect, and the volumes are the results of the estimates presented by Mr. Kesinger. The prices are fixed by the existing contract.

Page 9 of the exhibit is a summary of the operation and maintenance expense of Texoma Natural Gas Company. These items have been presented in various exhibits that were brought in by the operating personnel, and we show the figures here by year and by operating facilities. We also show the figures for regulatory expense, taxes and general expense.

Page 10 of the exhibit is a summary of the operation and maintenance expense of Natural Gas Pipeline Company. Except for the item of purchased gas, these expenses have been presented in previous exhibits and are merely a consolidation and compilation of those figures.

The caption "Completion Cost of Work in Progress January 1, 1939, None" referred to in a note at the bottom of page 4 means that there is no salvage occurring in the year 1939 for the work that was in progress as of the first of the year. On page 2, the last column, the first figure under "Total 1939-1954" is $1,055,990.

(At this point EXHIBIT 117 was offered and received in evidence over the objection of counsel for both Commissions who moved to strike the exhibit and the witness' testimony in connection therewith. The objections and motion were overruled and the exhibit was received in evidence. The Examiner allowed counsel for both Commissions exceptions.)

(Motion by Commission Counsel and Counsel for Illinois Commerce Commission to strike portions of Exhibit 98 denied.)

802 G. M. DAVIDSON, recalled by defendants, testified as follows:

Direct Examination by Mr. Hedrick.

(August 28, 1939.)

My name is G. M. Davidson. I am the same G. M. Davidson who testified in this case at Chicago on August 3. Supplementing my testimony as to qualifications and experience, particularly with reference to the natural gasoline

business, I spent twelve years directly in that business prior to joining the defendants. In the last four or five years of that twelve years, I was general superintendent of what is now Cities Service Oil Company, which had extensive natural gasoline plant operations. Since joining defendants, I have been responsible in an executive capacity for the operation of Texoma's Natural Gasoline Plant. I have been largely responsible for all negotiations in the sale of the product from this plant. I have kept informed during the past several years as to the going prices on the market of natural gasoline. I have prepared for presentation in this case information as to the prices which have been paid in the past for the purchase of natural gasoline. I am familiar with the revenues which Texoma has received for its gasoline and am acquainted with the places at which it has marketed its natural gasoline. I have an opinion as to the prospects for future marketing of that product. I am acquainted with the uses to which natural gasoline is put. This product is an extremely volatile gasoline. Most natural gas, whether produced with oil or as a dry gas, contains certain constituents which can be separated and liquefied, and these constituents are called natural gasoline. Natural gas, produced with crude oil, called casinghead gas, may contain from a fraction of a gallon up to twelve gallons of natural gasoline per thousand cubic feet. Dry natural gas generally contains about one-third of a gallon per thousand cubic feet. The average natural gasoline plant operating in the oil field, called a casinghead plant, will recover about two gallons per thousand cubic feet. The gas which is processed or handled at the Fritch plant is a dry gas. Normally the casinghead plants are operating on gas which is produced strictly with the oil with reasonable gas-oil rates. In the Panhandle there is a good deal of gas being produced from the stratas above the oil, not directly associated with the oil, but produced in the same wells as oil. This is called casinghead gas in the Panhandle. The gasoline which we manufacture is manufactured from a dry natural gas, and is the same gas which in turn goes into the pipeline of defendants.

In 1938 the natural gasoline production of the country was 5,800,000 gallons a day on the average. About 60 percent of this was produced in the Mid-Continent.

Natural gasoline is incorporated into motor fuel, and of the national motor fuel sold in the country in 1938, natural gasoline contributed 7.2 percent. Most of the natural gaso-

line produced is produced at casinghead plants, that is, plants processing gas associated with oil production. There is a very close relationship between the production of crude oil and the production of natural gasoline. That is to say, as the production of crude oil goes up or down, the quantity of natural gasoline produced in the country goes up or down. The gasoline plant operator contracts with an oil producer to treat his gas. They perform a service to
803 the oil producer in collecting the gas, and in redistributing the residue back to the leases for fuel purposes. The oil producer depends upon this service and he cannot afford to have many interruptions because it would affect his oil production. The quality of the fuel would change, and his apparatus, pumping engines, etc. would not be readily accommodated to the raw casinghead gas, or gas not processed for the removal of the natural gasoline, and he would suffer some loss in oil production. He is not willing to see many interruptions in the gasoline plant.

There is another factor contributing toward the continuous operation of the gasoline plant. That is the whole efficiency of these plants depends upon their continuity of operation. They cannot be interrupted at every price fluctuation of natural gasoline, because it takes time to get all of the distillation and fractionating equipment readjusted. Also, the gasoline plant operator cannot shut down because he would lose his experienced help and also his regular channels of market outlet. For those reasons, natural gasoline production is very closely related to the production of crude oil, and this relationship will hold regardless of price fluctuations.

In most oil production, though less true in the older fields, any field of recent origin will probably have a natural gasoline plant associated some place in the field with the oil production.

Natural gasoline can be produced by a number of processes. They are dependent upon pressure and temperatures. The larger number of plants are of the oil absorption type.

Going back to the relationship between the production of natural gasoline and crude oil, in the Panhandle field, and in other large gas fields, there is a relationship that exists between the production of natural gas and the production or manufacture of natural gasoline, because most of the dry natural gas produced in the country is processed for

natural gasoline extraction. The carbon black plants in the Panhandle field, for instance, under the laws of Texas, first process the gas for the production of natural gasoline before burning the gas in the manufacture of carbon black.

The only market for practical purposes for natural gasoline is to refiners for blending with their gasoline produced from crude oil, so that all natural gasoline finds its outlet through the motor fuel market. It can not be used in its raw state as a motor fuel. The refiners of motor fuel use natural gasoline to improve its volatility and to increase its octane number. This use, however, has been gradually decreasing in recent years. There still remains a seasonable demand by refiners for natural gasoline, particularly in the fall months, but even this demand is decreasing. I know of no other market for natural gasoline, other than the use by refiners.

By the term "volatility," I mean an evaporating characteristic of the liquid. Ether has a low boiling point and a high volatility. Mercury would have a high boiling point and a very low volatility. Gasoline is composed of a number of hydro-carbons, all of which have different boiling
804 points. However, the relation of volatility still holds by reason of more or less lighter fractions in the gasoline. Volatility can be gauged by distillation in an apparatus and procedure prescribed by the American Society of Testing Materials, and it can be gauged by its vapor pressure. Vapor pressure is a gauge of the total volatility of the product.

Octane number of the gasoline is a relative figure indicating its tendency not to knock when used in an engine. This octane number is obtained by operating a laboratory engine under prescribed conditions, with octane, a pure hydro-carbon, having a number called the octane number 100. All other fuels are referred to this octane rating, and depend upon the intensity of knock in this particular engine.

Many of the refiners are forced to use tetra-ethyl lead in their gasoline. However, they would like to avoid the use of this compound as it is extremely expensive. Natural gasoline having a high volatility and a high octane number is used by the refiner to increase the volatility and octane number of the products of his refinery. The necessity for the use of natural gasoline, however, is decreasing, as I have already stated.

Natural gasoline is quoted at two base points. It is

quoted on a North Texas basis, and on what is called a Group 3 basis. North Texas are the quotations applying to all gasoline produced in New Mexico, Texas and Louisiana. Natural gasoline produced in Group 3 would include all that produced in Oklahoma, Kansas and Arkansas. The freight charges on a shipment of natural gasoline will be such that the gasoline produced in each of these areas will have its market outlet. I mean by that, that North Texas cannot economically ship to the Chicago market in competition with natural gasoline being shipped from Group 3. I want to make the point that it is obvious that the freight rate for the North Texas Group may be different for gasoline shipped from the Panhandle to the Gulf Coast than from the Gulf Coast fields themselves. There is a difference in the freight rate within the area, but it would cost more to ship natural gasoline from the North Texas area than it would from the Group 3 area to Chicago. This term "Group 3" was developed between the railroads and the oil industry. The only groups that we have to deal with in the sale of gasoline from our plant are Group 3 and North Texas. I can't answer the question as to what is Group 1 and Group 2; I have never heard of them; I don't believe that is in the Mid-Continent area, or I would have knowledge of it.

Natural gasoline prices are quoted in Platt's Oilgram daily. Those prices are based on natural gasoline of a specification known as Grade 26-70. I should say that these quotations are based on spot shipments for the day. I mean by that, all sales that were made outside of contracts existing between, say, a natural gasoline manufacturer, his marketer, and the refinery. There are a number of different grades of natural gasoline. All of them are referred to this one grade which is quoted, with a percentage differential fixed by agreement between the buyer and the seller and based on the quoted price for this grade 26-70. Grade
805 26-70 specifies a grade of natural gasoline which has a vapor pressure of 26 pounds at 100 degrees Fahrenheit and a minimum distillation of at least 70 percent at 140 degrees Fahrenheit under the American Society of Testing Materials standards for distillation.

Ordinarily natural gasoline is shipped in special tank cars, equipped with an insulated jacket on them and with unusually large expansion domes on the tops of the cars. Some gasoline is shipped by pipeline, some as natural gasoline and some is put into the crude oil for transporta-

tion to the refineries and later distilled along with the crude oil distillation. The freight charges are paid by the buyer. The larger producers maintain their own sales organization and own their own tank cars. The smaller producers use the services of marketing companies who supply these tank cars, and find a buyer for the product. Generally, the natural gasoline manufacturer pays from ⅛ to ¼ of a cent per gallon, as a marketing charge, and in addition he is charged with outage and freight on outage and freight equalization, if any. In other words, if the price of natural gasoline is 3 cents, there would be a deduction from that price of this marketing charge, which ranges from ⅛ to ¼ cent per gallon. That is in the case of a small producer that is using a marketing agency; I was also speaking of an integrated company where the charge is probably interdepartmental and of no consequence.

We do not have a marketing organization, but deal through outside marketers. At the present time Texoma has two marketing organizations: Phillips Petroleum Company and the Columbia Gasoline Company.

By "outage" is meant the volumetric loss of the natural gasoline in transit. In spite of the insulated tank car, an outage percent occurs because of the increase in temperature while the car is in transit, and also because it is necessary to reduce the pressure in the car at destination by venting the car before it can be gauged. An average tank car holds 8100 gallons. The outage will probably average 50 gallons a car for the year around. In the summer, it may get up to 5 percent, or 400 gallons. The 50 gallons is a very rough average. It would range considerably less than that up to about 400.

"Freight on outage" is occasioned because the refiner or the buyer is paying the freight. He is charged freight by the railroad on the basis of the tank car capacity. If the car holds 8100 gallons he will pay on that basis. If he receives but 8000 gallons, there will be an outage of 100 gallons for which he will charge the natural gasoline manufacturer the freight on that volume loss.

"Freight equalization" is brought about when the normal outlet for the gasoline being shipped, say from North Texas to Gulf ports is closed. That is, the marketer cannot find a market in the normal competitive area for that group. Now if the marketer can find a market, say in Chicago, for his gasoline produced in Texas, then the gasoline manufacturer will absorb the difference in freight between Group 3 to

Chicago and North Texas to Chicago. Thus, in addition to the marketing charge of one-eighth to one-quarter cent per gallon, the manufacturer must stand or pay for the outage, freight on outage, and freight equalization, if any.

806 The reason for the decreasing necessity for natural gasoline in the refining of motor fuel is that in previous years natural gasoline was an absolute necessity for a refiner if he was selling a competitive grade of motor fuel. The improvements made in refining technique are so marked that there has been a decreasing necessity on the part of the refiner for the use of natural gasoline, with a consequent reduction in the price of natural gasoline. It is true that there is still a seasonable demand for natural gasoline in a few fall months, but I have already stated that such demand is decreasing. Through the remainder of the year the refiner purchases natural gasoline for its merit, but he will not pay any more for that natural gasoline than the cost of manufacturing his finished product. By this I mean, in saying that he will not pay any more for it, to include his purchase price and his own costs in handling natural gasoline.

For instance, a refiner, through all of the improvements which have been made in refining technique, is able to turn out a finished and acceptable competitive motor fuel, and he has another gasoline which he can bring up to the same specification with the use of natural gasoline. He will buy natural gasoline for the improvement of this product, but he will not pay any more for it than what his finished cost would be for the product which he can make with his own facilities. To state it differently, the refiner during the past few years, through increased efficiency and refining technique, is able to manufacture a product which is a substitute for natural gasoline, and he is able therefore to make a motor fuel of at least equal quality to what he formerly made when he purchased natural gasoline as a blending agent, and that motor fuel so manufactured costs him a certain amount of money, and he is not willing to pay more for the natural gasoline, as a blending agent, than it would cost him to manufacture the same quality of motor fuel in his own plant without the aid of natural gasoline.

The improvements in refining technique which have

reduced the necessity for using natural gasoline as a blending element have to do with the cracking processes recently installed. These include the tail gas recovery plants at the refineries, the reforming plants, the catalytic cracking plants, polymerization and hydrogenation processes, and the general improvements in fractionating at these refineries, besides the improvement which has been made in the quality of the crude being delivered to refineries. These improvements have the effect of enabling the refiner to increase the volatility and the octane number of his products.

The cracking process in general is the destruction of the heavy molecules into lighter ones, and in making a light gasoline from what formerly may have been fuel oil or gas oil, or something of that character.

A tail gas plant is in effect a natural gasoline plant operating on the uncondensed vapors at a refinery. The modern refinery will have the equivalent of a substantial natural gasoline plant operated in connection with its operations. Tail gas simply means what has heretofore been left over which the refiner was formerly not able to use but which he now processes.

807 A reforming plant to some degree is comparable to the cracking plant in that it changes the molecular structure of a liquid from a heavier liquid to a lighter liquid, making an acceptable motor fuel. Within recent years, in addition to the normal cracking processes which were dependent upon elevated pressures and temperatures, a number of processes have been developed which use a catalyst. In the process this catalysis has the effect of accelerating the breaking down of the molecules, and in several of these processes there have been rather remarkable results, particularly on the high octane values.

"Polymerization" process and the hydrogenation process are the reverse of the cracking process, in that they take the lighter molecules and re-combine them in a process which will make a gasoline. Hydrogenation process is quite comparable with the polymerization process in that it converts lighter hydrocarbons to the heavier and makes an acceptable motor fuel.

There has been a remarkable adaptation of all these improvements in refineries in late years. Trade journals such as the Oil and Gas Journal indicate the expenditure of a hundred million dollars already made by refiners for

such improvements. I expect that these improvements will be accelerated. I have an opinion as to whether or not the decreased use of natural gasoline in the manufacture of motor fuel will have an effect on the volume of natural gasoline which will be manufactured in the future. Natural gasoline will be produced in the oil fields so long as the natural gasoline man can show a profit on his transaction. The contractual relationship between the natural gasoline manufacturer and the oil producer is such that with a decreasing unit price for natural gasoline the payment to the oil producer for the privilege of extracting the natural gasoline will decrease. Naturally that will contribute towards a larger profit for the natural gasoline manufacturer and he will be able to manufacture natural gasoline down to a very low figure.

In spite of the lower return to the oil producer the service performed by the natural gasoline manufacturer for the oil producer is still conducive to the sale of casinghead gas by the latter. The decreased necessity for the use of natural gasoline will have no effect on the amount of natural gasoline produced from the gas transported by the pipelines. This is true because the natural gas pipeline transmission systems process their gas to improve the efficiency of transmission, as well as because of the profit motive in their operation of natural gasoline plants. For instance, if the price of natural gas were cut down to a point where it was not profitable for a natural gas company to manufacture natural gasoline, it would continue to extract the gasoline, regardless of price, so long as we had a market outlook.

(At this point counsel produced a document, in graph form, entitled "Monthly Average Price of Natural Gasoline and U. S. Motor Fuel", which the Examiner directed the reporter to mark as Exhibit 119 for identification.

Counsel also produced a graph, entitled "Ratio of the Yearly Average Price of Natural Gasoline to the Yearly Average Price of U. S. Motor Fuel", which the Examiner directed the reporter to mark as Exhibit 120 for identification.)

I have prepared a graph showing the prices of natural gasoline in the past and the prices of motor fuel in the past. Exhibit 119 shows the monthly average price of natural gasoline and U. S. motor fuels. The source of this information is indicated on the graph as published

by "National Petroleum News". That is one of the trade journals of the oil industry. It shows an Oklahoma
808 price of motor fuel between January, 1919, and November, 1922. It shows the comparable price of natural gasoline for that period. The North Texas market was indefinite at the time and the point I am trying to bring out by these graphs can be brought out with the relationship of the Oklahoma prices within that period. The graph shows the predominant grades of natural gasoline and motor fuel being traded in since that time based on the North Texas market. For instance, you will note "Grade A-72-78 North Texas, Natural Gasoline, December, 1922, to September, 1924." At that time natural gasoline was being graded on a different system than it is today, but that grade was the predominant product being sold. The same applies to the motor fuel being sold since that time. You will notice the point that I was making, that the octane rating of motor fuels has been increasing and the grades specified in November, 1931, to July, 1934, were made on a 65 octane rating, whereas today the octane rating of the motor fuel being dealt in mostly is 70 to 72.

The types of natural gasoline under the heading "Sources of Information" on the left side refer to the top graph on Exhibit 119 entitled "Natural Gasoline" and the types of gasoline on the right side refer to the lower graph on Exhibit 119 entitled "U. S. Motor Fuel". The horizontal scale in both the upper and lower graphs is a time scale between the years 1919 and 1938, each inclusive. In each year we have 12 divisions for the months of the year and the initial for the month is plotted on the top line of the top graph. For instance, in March, 1919, the price of natural gasoline was 24 cents. If I am reading this correctly, for that same period, motor fuel was selling for about 18 cents per gallon. The vertical scale in both graphs indicates the monthly average price, for natural gasoline on the top scale and for motor fuel on the lower scale. These are prices, in the case of natural gasoline, at the gasoline plant, and in the case of U. S. Motor Fuel at the refinery, without tax or without freight.

It is very obvious that the price tendency has been downward from 1919 to 1938, inclusive. I would like to make one other point with reference to these graphs.

Within each year on this graph we have plotted a small circle which shows the average price prevailing for the year. That is true on the top graph as well as the bottom graph on Exhibit 119. For instance, on natural gasoline in 1919 the average price was approximately 23 cents, and in the same year for motor fuel the average price was 17½ cents per gallon. In the year 1938 the average price of natural gasoline was slightly over 2½ cents per gallon and for motor fuel the average price was slightly less than 5½ cents per gallon. The average price tendency for natural gasoline for the last seven years, as is shown on Exhibit 119, remains the same or has gone up.

Exhibit 120 shows the price relationship that has been existing between natural gasoline and motor fuels. It is expressed as a ratio of the yearly average price of natural gasoline as a numerator and the yearly average price of motor fuel as the denominator. For instance, with a ratio on the vertical scale of one, the price of natural gasoline and the price of motor fuel would be the same. The horizontal scale in this graph covers the same period of years as that for Exhibit 119, and the curve shown is the relation between the circle points in Exhibit 119. I call your attention to the period between 1920 and 1926. There is some variation in this ratio, but you will find that the price of natural gasoline was approximately equal to the price of motor fuel. In
809 that period the refiner had to purchase natural gasoline at a loss to him, because in addition to the purchase price itself the refiner had to pay the transportation and the handling cost at his refinery. Now you will notice that there is a decided increase in tendency to decline in this ratio to the point where for the year 1938 the ratio was less than one-half. In other words, the price of natural gasoline is now less than half the price of motor fuel. If the tendency of this curve continued it would indicate that the value of natural gasoline would soon be zero. However, I do not predict that that is going to occur. There is some price at which these refiners can purchase natural gasoline at some profit to themselves. Prior to the year 1926, the price of natural gasoline exceeded the price of U. S. motor fuel. Since 1926, the price of natural gasoline has been less for each year averaged than U. S. motor fuel. The average year

in question to which I refer is directly above the figures showing the year. It is on the line. There is no significance particularly in the slope of the line itself for the intervening period because the points themselves indicate the average for the year. I simply connected the points with a line. The ratio between natural gasoline and U. S. motor fuel, say in 1929, is shown directly above the figure "1929" and is approximately 97. That represents the relationship between the circles shown under the columns marked "June, 1929", of Exhibit 119 in the natural gasoline charts and the U. S. motor fuel charts. By motor fuel, I mean gasoline sold through service stations.

I obtained the average price for the year for natural gasoline and for motor fuel, shown on Exhibit 119, by computation of the average for each month, and adding these computations together and dividing them by 12. It is a numerical average of the monthly averages and not a weighted average on the basis of the fuel consumed. I believe these exhibits show decidedly that the value of natural gasoline to the refinery is decreasing. I have an opinion or judgment as to what price as a maximum will prevail in the future during the life of this project. My judgment is that natural gasoline will sell at some differential below the price of motor fuel in the future. I have stated that the average price which we can expect the refiner to pay will be that which will be not greater than he can pay on an exchange basis, that is without profit. It may be that in the future he will demand a profit. However, I have not taken that into account. I have used as the basis of my prediction a differential which will be at no profit to the refiner.

I have computed the cost to the average refinery for handling natural gasoline. I know that this cost will be 2.2 cents per gallon. Now the average price of motor fuel in the North Texas field within the period of 1931 to 1938, inclusive, is 4.85 cents per gallon. Deducting the 2.2 cent cost to the refiner for handling I arrive at a price for natural gasoline at the manufacturer's plant of 2.65 cents per gallon. I chose the price of motor fuel over the period from 1931 to 1938 because that is a period when we have had some wide fluctuations in the price of crude oil. It is a period when there has been an abundance of crude oil, which situation prevails today. In fact, there are more crude oil reserves in sight at this

time than there ever have been. In 1929 or 1930 there was some 8 or 9 years' supply of crude oil in sight. Today that figure is 15 or 16 years, at the present rate of consumption. I see no apparent reason for the price of motor fuel to increase with this abundance of crude oil. I mean at least during the 16 years of defendants' life.

810 In arriving at the 2.2 cents, I have taken into consideration the freight cost to the refiner in shipping the natural gasoline between the natural gasoline plant and the refinery. I have included the refinery blending losses and the labor involved in handling the tank car, in testing it, and his overhead cost. The difference in price between motor fuel and natural gasoline in 1938 was 2¾ cents per gallon. The price of 2.65 cents, which I have testified to, is substantially the average price of natural gasoline on the North Texas market in 1938, which was 2.63 cents per gallon. Up until the end of July, 1939 the average price was 2.60 cents per gallon. These are the last full months on which I have the figures.

Texoma's plant is what is known as an oil absorption plant, originally designed to handle 190,000,000 cubic feet but we have put as high as 230,000,000 cubic feet a day through it. The average production would probably be 70,000 gallons daily. A 70,000 gallon plant would probably be rated among the first ten in the country and I think third in the Panhandle. I have prepared an exhibit showing the future revenues which Texoma will receive from the sale of natural gasoline.

(At this point counsel handed to the reporter a document entitled "Texoma Natural Gas Company Future Gasoline Recovery, Sales, and Revenue, G. M. Davidson, Witness," and at the direction of the Examiner the reporter marked such document as Exhibit No. 121.)

Exhibit 121 is divided into five columns, the first column showing the years between 1939 and 1954; the second column indicates the average recovery which will be made at this plant in gallons per million cubic feet on a 14.65 pound pressure basis. This recovery has been established on the basis of our experience for the past three years in which we recovered 326 gallons per million cubic feet. I have obtained the figures for the gas production of Texoma for the future from Moore County as one general area and from Carson-Gray area as the other and have included the Canadian River gas. That is the gas which we pur-

chase from Colorado Interstate Gas Company, amounting to one-fourth of the requirements of Natural Gas Pipeline Company of America. I used the term "Canadian River Gas Company" because that happens to be the company which produces the gas purchased by us from Colorado Interstate Gas Company. This natural gas is delivered to the Fritch compressor station of Texoma and is processed for the extraction of natural gasoline.

Questions by the Examiner.

When I gave these other figures on the quantity of gasoline that would be recovered from dry gas and casinghead gas I was stating figures based on 14.65 pounds pressure.

Direct Examination Resumed by Mr. Hedrick.

The proportion of gas which Texoma will produce in the future will change between Moore County and the Carson-Gray area. In other words, a lesser quantity of gas will be produced from the Carson-Gray area and more will be produced from the Moore County area in the future than in the past. That will have the effect of decreasing the aver-
811 age recovery in gallons per million cubic feet. We have established that we can recover 316 gallons per million cubic feet from the gas produced in Moore County, 347 gallons per million cubic feet from the gas produced in the Carson-Gray area, and 311 gallons per million cubic feet from the gas produced from Colorado Interstate Gas Company.

I arrived at the figures shown in the third column captioned "Volume Gas Through Fritch MCF/Year (14.65#)" from the sales for the future plus the fuel requirements of the system, plus the line losses, and also the handling or processing losses through the gasoline plant. The quantity of gas which will pass through the gasoline plant will be in excess of the quantity which finally reaches the market. I have heard the testimony of the witnesses who have testified as to the reserves of defendants. These reserves were computed on a pressure basis of 16.4 pounds per square inch. In Mr. Kesinger's testimony, his basis was 14.65 pounds. There is no conflict between Mr. Kesinger's and my own testimony on the pressure basis.

I arrived at the figures contained in the fourth column

entitled "Sales Gals/Yr.", which of course means sales in gallons per year, by multiplying the volume output in million cubic feet times the recovery per million cubic feet and then deducting a processing loss at the plant of 4.1 percent, which is the loss reflected by our experience and is accounted for by the treating, transferring and loading of the product.

I arrived at the figure in the fifth column under the heading "Gross Revenue Dollars Per Year" by multiplying the sales in gallons times the price of 2.65 cents per gallon less 2 percent, which are the terms of our present marketing arrangement effective until June 1, 1940, and after that period I have deducted 3/16 of a cent per gallon to cover the marketing cost; that is, to cover all of the merketing cost not only the direct charge of the marketer but also the outage, the freight on outage and the freight equalization. The reason I did not deduct 3/16 of a cent from the first of 1939 until June 1, 1940 is that our present market outlet is with the Columbian Gasoline Company for 50 percent of the plant production. This natural gasoline is shipped in tank cars. The remaining 50 percent is sold to Phillips Petroleum Company at the gasoline plant by pipeline delivery, the pipeline belonging to the latter company, the pumping equipment belonging to us. The present marketing arrangement that we have is one that is exceedingly favorable to us. The only cost for marketing is a deduction of 2 percent of the volume being shipped to each of these companies. It has been brought about by a competitive situation which has existed between these companies. These contracts expire on June 1, 1940. I have a definite opinion that we will not be able to renew the contracts under such favorable terms.

My opinion is based on the circumstance that at the time of the execution of the contract covering the period ending June 1, 1939, Phillips Petroleum Company found itself short of natural gasoline and competed with Columbian Gasoline Company for that year on a basis which gave us the same contract which is now in existence. It was strictly a competitive situation. At the termination of this last contract we were busy with this hearing and at the
812 first opportunity after recess we contacted the Phillips Petroleum Company and rather forced the issue on a settlement for the following year's production. It was a question of either take it or leave it almost, and on such short notice the Phillips Petroleum Company could

not readjust their supply to any other source, so they accepted the renewal of the contract which had been made the year previous.

In this last deal with Phillips Petroleum Company, I formed an opinion that we are not going to renew that contract. The basis of that opinion is that on the occasion of the last renewal we gave them such short notice to say yes or no to the renewal of the previously existing contract that they could not readjust their source of supply. They came to us with a proposition whereby the marketing charge would be considerably greater. It was turned down. However; with another year in which to make arrangements for another source of supply for natural gasoline I do not believe they are going to renew that contract. Now with the Phillips Petroleum Company out of that competition I also know that the Columbian Gasoline Company are not going to renew their contract for the remaining half of our gasoline under that former basis. We have in the past paid as high as 5/16 of a cent for this marketing charge.

Cross-Examination by Mr. Slaff.

When I say "I know that Columbian is not going to renew its contract," I mean that that is my impression; I feel that strongly about it in my judgment.

Direct Examination by Mr. Hedrick Resumed.

(At this point EXHIBITS NOS. 119, 120 and 121 were offered and received in evidence, the latter over the objections of counsel for complainant and the Commission, who were granted exceptions. Motion by Commission's counsel and counsel for Illinois Commerce Commission to strike testimony connected with the exhibits denied.

At this point counsel handed to the reporter a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company, Salvage Value as of December 31, 1954." At the direction of the Examiner, the document was marked Exhibit No. 122 for identification. Objection by counsel for the two Commissions overruled.)

I have prepared an exhibit showing an inventory of the salvageable materials and properties, both real and personal, which each of defendants will have on December 31, 1954.

Page 1 of this exhibit marked 122 for identification is a recapitulation of the salvageable material of Natural Gas Pipeline Company of America in the property which it owned as of June 1, 1939. The details of that sheet are set out in subsequent pages of the exhibit. On page 1 are shown Accounts Nos. 1000, 1002, 1005, etc. Those account numbers are carried forward for identification purposes.

This first page shows the total salvage value of the property, the cost to reclaim that salvageable property, and the net salvage value of the property in existence on June 1, 1939.

Page 2 is a recapitulation of the salvageable material of Natural Gas Pipeline Company to be added after June 1, 1939. I secured the information as to the additional property to be added after June 1, 1939 from the testimony and exhibits of those who have testified to that effect; namely, Strong, W. H. Davidson, W. T. Bulla, R. M. Bussard, S. E. Campbell, myself, Powers and Mr. Dickinson. In listing the salvageable property of these companies, I have taken into consideration replacements of present existing property. For instance, if a river crossing were taken out and another river crossing put in, that would be a replacement. Only net additions to plant are reflected in this exhibit.

813 Page 3 is a recapitulation of the salvageable property of Texoma as of June 1, 1939.

Page 4 is a recapitulation of the salvageable property of Texoma to be added after June 1, 1939.

Page 5 is a statement of the salvageable warehouse stock of Natural Gas Pipeline Company of America, the top items being as of June 1, 1939, and the lower items property acquired after June 1, 1939.

Page 6 is a statement of the salvageable warehouse stock of Texoma as of June 1, 1939.

On page 7 is a recapitulation of the salvage values as shown by pages 1 to 6, inclusive. I have simply taken the salvageable property of the two companies and added those together to get the totals here.

Page 8 shows the value of No. 1 heavy melting steel in the scrap market at Chicago, as quoted from the Chicago Journal of Commerce in dollars per gross ton of 2,240 pounds, between the period August 31, 1925 and August 31, 1938. It shows at the bottom of the page that the mean average for the past 14 years is $11.50 per net ton, a ton of 2,000 pounds, and that the price prevailing on June 1,

1939, was $11.38 per net ton. A footnote at the bottom indicates that the value of mixed scrap, a combination of cast iron and steel, is valued in the trade at $2 per ton less than the value of No. 1 heavy melting steel. This deduction has been uniformly used throughout this period. These quotations from the Chicago Journal of Commerce, the market prices for No. 1 heavy melting steel, are as of the dates shown on page 8 at Chicago. By "gross ton" I mean a ton of 2,240 pounds, and by "net ton" I mean a ton of 2,000 pounds. In the exhibit I have used net tons, and the cost per gross ton is only shown for information purposes, and for the reason that that is the tonnage figure used in the Chicago Journal of Commerce. The term "mean average" simply means arithmetical average.

Page 9 shows the freight rates as they existed on June 1, 1939 for scrap iron and steel in minimum carload lots of 75,000 pounds from the shipping points along our pipeline, described as Station 1, Fritch, Texas, etc., to the market at Chicago, which is practically the only market for the scrap material available. In figuring freight rates when the material is shipped from Texas we used the Fritch freight rate of $7.20 per net ton. When the material would be shipped from Joliet, Illinois to Chicago, we used $1.06 per ton. When the property would be shipped from any of the other points shown, that is Perryton, Texas, Minneola, Kansas, and so forth, we used the freight rate applying to a mid-point on our line located as of Beatrice, Nebraska, Station No. 6, $4.40 per ton. We found that that is the average freight rate that would apply to the salvageable material that would be sold as scrap. By a minimum carlot of 75,000 pounds is meant that if you do not fill your car to that 75,000 pounds, you still pay the freight on 75,000 pounds.

Page 10 shows the market value of No. 1 scrap copper at Chicago as quoted by the Chicago Journal of Com-
814 merce over the period from August 31, 1925, to August 31, 1938. It is expressed in cents per pound and shows the spread of prices. For instance, on the line August 31, 1925, it shows a spread of 11.75 cents to 12 cents per pound. The 14-year average on the next to the bottom line shows that the average has been a spread between 8.53 cents per pound and 8.87 cents per pound. On June 1, 1939, there was a spread from 7.25 cents to 7.75 cents. We have used, in our salvage study, the average of 7.5 cents per pound.

Pages 11 to 102, inclusive, contain a breakdown of all the property shown in the recapitulation, pages Nos. 1 to 6, inclusive. Page 11 shows Natural Gas Pipeline Company Account No. 1000—Lands in Fee. We have listed the fee lands of that company on that page of the exhibit. Line 1 of this exhibit shows that at Compressor Station No. 2, located in Oklahoma, we own in fee 30 acres. We are going to sell the equivalent of seven and a half acres at a going value of $15 per acre. We will realize cash from this sale of $112, and the last column shows that the cost to demolish and clear the foundations on this site will be $3600.

Cross-Examination Interposed by Mr. Slaff.

We are going to give the other 22½ acres to whoever will buy them; we are going to sell the 30 acres and are going to receive from the sale of that acreage $112. The reason we will spend $3600 to demolish and clear the foundations on this site is that, upon advice from our legal department, we cannot leave this site in a hazardous condition because of the liability that we could incur before the sale, and they have advised us that it would be necessary to clear the site to eliminate any liability from this source. It will be sometime before we can sell this land after the property on it is salvaged. While it is in our possession we would still be liable. A reasonable estimate of how long it is going to be in our possession before we will sell it would be from a period of months up to five years; during that time we figure there would be a hazard in maintaining the property and leaving it there; that is the explanation of why we are going to demolish the property before we sell the land.

Direct Examination Resumed by Mr. Hedrick.

Page 12 shows the salvage cost of the railroad crossings of Natural Gas Pipeline Company at the 57 railroad crossings owned by that company.

Page 13 shows, under Account No. 1005, the main lines and the gate valves and other similar property of that company as of June 1, 1939. With a few exceptions, we have shown the length in feet of the main pipe-line, for instance, and the tonnage of that pipe. Where we were in-

volved with the weight, we showed it as pounds or tons. When we were involved with a percentage of the cost of thet product, we showed the cost of the product so that the percentage could be applied to that. That is on other pages of this exhibit and not this particular page. This particular page shows only the weight and in some instances the length of the pipe. Up towards the upper right hand corner, the words "not salvageable" occur. That information was secured from other witnesses who will testify as to that. In order to put this exhibit in one piece I conferred with those witnesses and from what they told me they would testify to, I put that information in here. Right below appears the terms $20 a ton, $15 per ton, and $5 per ton. $20 a ton indicates the total salvage value of 362.66 tons shown at the bottom of that page, which will be salvaged. The $15 per ton is shown under the column "Cost to Reclaim", and is the cost to salvage the equipment shown as a total of 362 and a fraction tons. Where the term "Not Salvageable" is used, we are not attempting to reclaim that property at all, but are leaving it where it is. That particular segregation of data was
815 put in there only as a matter of interest because of the large tonnage involved, and so as to account for it in summing up the salvage. The term "Net" between the caption "$15 a Ton" and "$5 a Ton" means that we will obtain the difference between the cost of reclaiming, $15, and the total salvage of $20 per ton, leaving $5 per ton net salvage value.

Turning to page 14, which is a continuation of Account No. 1005, under the last three columns appear the words "1138/Ton" "1106/Ton" ".32/100N". This is a typographical error and should have read "$11.38 per ton", "$11.06 per ton', and "$0.32 per ton'.

On page 16, the words "cor. ir.", on the first line, mean corrugated iron. The breakdown of the main compressor buildings, shown on the second line at $89,303, is shown directly below on the same page and the item of the auxiliary and other steel buildings at all stations, of $79,080, is broken down on pages 17 to 19, inclusive, of the exhibit.

The group of figures near the bottom of the page, the first one of which is "Station 2, Mississippi Valley Structural Steel Company, 68 x 168 x 28' 9" " showing an original cost of $9,602, refers to the original cost of the salvageable material contained in the building alone. The next column to the right shows a 28 foot extension cost-

ing $2,435, which means that subsequent to the original erection of this building we added a 28 foot extension to one end. These extensions were all added in 1938, and of course prior to June 1, 1939. The original cost of the entire building, therefore, is the sum of $9,602 and $2,435, which is the total to which any percentage will be applied.

On page 22 the first line shows that at Station No. 2 we have two 15 horsepower General Electric 440 volts, 1,750 revolutions per minute, motors. The last line of that same group shows an item "2-40-50". This item is really a 40 horsepower motor, although this is more completely described in the valuation report which is to follow in terms of 40-50. We wanted to identify it so that it could be cross-checked for a more complete description. In other words, there are 2-40 to 50 horsepower motors.

On page 24, the top line, "48-1250 hp. Wor. Hor. G. D. Compr." means 48—1250 horsepower Worthington Horizontal Gas Driven Compressors. In the next line the initials "PIW" and the following initial in which there is a typographical error—that "D" should be an "O"—indicates the manufacturer, Petroleum Iron Works in one case, and O. A. Smith in the other.

On page 25, the initials in the first line, for instance, mean that we have 18 Cooper-Bessemer 175 Kilowatts generating plants, making a total of 2,250 kilowatts. Four lines below that, the words "Robbins & Myers" refers to the manufacturer of a generating set with panel. It is a motor-driven ignition set, a small unit. In the group of figures at the bottom of the page, the first line, the letters "C. P." stand for Chicago Pneumatic, a manufacturer.

816 *Cross-Examination Interposed by Mr. Slaff.*

Where I stated above that the figures in the first line show a total of 2250 kilowatts, the total should be 3,150 kilowatts. That will change the salvage figure from $11,250 to $15,750. The difference between $11,250 and $15,750 carries down into my first total of $18,499 and then into my final totals of $19,236 and $18,498.

Direct Examination Resumed by Mr. Hedrick.

On page 26, the first line, the abbreviation "Aux." means auxiliary. The letter "M." means main.

On page 27, fourth line, "Galv. Dom." means galvanized domestic.

Page 29, near the bottom, over at the left hand side, the figures "919,499" and "470,588" mean pounds. These figures are converted into tons in the first column.

On page 30, the first line means 2025 feet of 400,000 circular mil copper wire, weighing 1.24 pounds per foot. The next line means 70 feet of No. 0000 wire, 3-conductor, weighing 1.9215 pounds per foot. In the fourth line, the initials "DBRC" mean double braided rubber covered. In the seventh line below, the initials "TBWP" mean triple braided waterproof.

On page 29, in the column under "Total Weight," where I have 459.7 tons, there appears to be a comma or a blur or something right before the figure. That should not be there.

On page 34, the first line under the word "Oklahoma," the letters "BWG Cu." means B and W gauge copper wire. Cu. is the symbol for copper.

On page 40, the top line shows "Supercompressibility Apparatus: —", and right below that you will find the words "Special Gas Measuring Device." In mimeographing, this first line should have been put over two spaces. The "Supercompressibility Apparatus" was modified for further explanation by "Special Gas Measuring Device," which should have followed on the same line; and following "Supercompressibility Apparatus," there should have been a comma. There is no significance in the first line being set off by itself the way it is. In the second line from the bottom where it says "Dew Paint Instrument," and "a" should be an "o," and the expression should read "Dew Point Instrument."

Page 34 shows the entire salvage from the telephone system.

On page 42 occurs the expression "Total Salvage 30%." That should have read 20 percent. That 20 percent does not apply to the law library.

On page 71, the initials and abbreviations in the first line mean 1-300 horsepower, 60 cycle motor with compensator and breaker. Several lines below, there appears the item "2-Clark Eng. #2 Comp." et cetera, which means Clark Engine #2 Compressor. That "S. B." is an abbreviation for the size of the compressor cylinder, which is 6 by 20. The last line means one 8-1—that zero is a typographical error and it should be 8-½ by 12—Westinghouse steam air

compressor. The amounts shown throughout the exhibit under the heading "Cost to Reclaim" were obtained from consultation with witnesses who are to follow, or they are based on my judgment and experience in a few cases, which I will explain later. The figures which express my own judgment are those in Accounts Nos. 1000, 1002 and 1008 for both companies.

817 Exhibit 56 is a picture of a typical compressor station on the main line. This one happens to be compressor station No. 6, located near Beatrice, Nebraska. It is rather unusual to have such a good road alongside of a station. All buildings and superstructures of all character have been treated as salvage, but there will still remain the foundations and pits for the buildings, the cooling towers, etc. The foundation for these buildings is about 24 by 30. I am referring to the cottages, at figure 17. These are concrete foundations that have walls 2-½ to 5 feet in height, with a center wall extending down the center of the building. They will have to be demolished to ground level. I should say that this picture does not reflect the additions which have been made in the plant to date; and when this plant is demolished or salvaged in 1954, there will be an average of 15 houses at each one of these stations. There has been an extension made to the cooling tower, shown as figure 12. There has been an extension on the main building, No. 1. There has been added a pipeline warehouse comparable to building 14, and there have been extensions on the garages noted as 16. In addition, there is a foundation about a foot high under these garages which have been extended since this picture was taken. This building is about 20 feet wide and now about 60 feet long, and the walls are about eight inches thick in this low building here. They are not made of reinforced concrete.

Now we have this elevated domestic water tank here at figure 15 which is supported on some concrete blocks which will have to be removed. They are about 18 inches square and are up above the ground about a foot or 18 inches. Now as to the pipeline warehouse, figure 14, this is a special warehouse to the extent that it is built to facilitate rolling trucks, and this foundation is elevated above ground practically four feet, and in some cases where the warehouse is on a slope, the walls get up to eight feet high.

This compressor station No. 6 is typical of other compressor stations, and the description which I am making of the work to be done is also typical of the other stations.

At one end of this pipeline warehouse we have a pit dug underground for the storage of pipeline rubbers and other material. This pit is about five feet below ground and 20 feet into the building itself. In addition there are two cross walls in these buildings which elevate an inside platform. This concrete foundation is about ten inches thick and is reinforced. At figure 13 we have typical pipeline pipe racks, and these have been extended since this picture was taken. To support these pipe racks there are numerous concrete blocks about 18 inches square and on about five-foot centers for a length of 40 f et. Then at the cooling tower we have a concrete foundation which now is 24 feet in width, about 100 feet long, and has a pit half of which is in this picture which is about 10 feet deep. There is some heavily reinforced concrete here including column supports for the tower itself.

Proceeding into the piping at figure 11, there are a great number of anchors to hold down the pipe from vibration in this vicinity. There are a number of anchors which cannot be seen in this picture, but I would say that there are about 25 or 30 concrete blocks, all of which extend above the ground a foot to four feet. We have in addition to that the main building which has been extended 28 feet more, as is reflected in Exhibit 122, and in addition at Sta-
818 tions 2, 3 and 9 the building is 28 feet longer than that.

This building here is about 70 feet wide and has a basement extending half of its length down below ground about six or seven feet. There are walls running through this basement that are about 10 or 12 inches thick to support, along with the column foundations, the heavy type of building that we have here. It is very heavy concrete and rather difficult to break out. That pit would have to be filled up.

In the building itself the concrete blocks under these main units are rather massive affairs. They are about 15 or 25 feet in width, they are about 50 feet long and about 12 feet deep. They extend above the ground line approximately two and one-half feet. They are heavily reinforced concrete. Besides containing anchor bolts and the ferrules for the anchor bolts, it is chuck full of steel. They all have to be broken at least down to the ground line. We will have to get rid of the concrete by filling up the pits with it.

Going now to the auxiliary building, that structure is about 30 feet wide and approximately 130 feet long. It carries a foundation under it which has a 10-inch wall

which extends clear around the foundation excepting at one end where we have a pit the width of the building and extending into the building 30 feet. That pit contains the pumps for the water circulating system. The floor line in this building is about 18 inches above the ground line. Then we have the two auxiliary units with a heavy concrete block under each of them about five feet wide and 18 feet long, and this block is under the engine and under the generators and has to be a very solid block to hold this engine from vibrating. Under the boilers we have a rather heavy foundation. It extends above the ground line about two feet. It is of reinforced concrete and will have to be broken out. Then we have the foundations under the machine tools in one part of the building. We have the foundations under the air receivers that will have to be broken out. Referring to the elevated water tank, at figure No. 9, this structure is reinforced concrete blocks about three or three and a half feet square. It extends into the ground about five feet, and then at the center, at the standpipe, we have a concrete block about eight feet square which extends up above the ground line 18 inches.

There is a pit under the building at figure 10, ten feet deep. This is a 10 by 10 sump house. At figure 6 we have a 30 by 30 concrete hot well which is 10 feet deep. The walls of this pit are about 10 or 12 inches thick and heavily reinforced. At No. 7 we have the foundations for the lubricating oil tanks. They will have to be knocked out. These are about 12 inches thick, five feet long, and they elevate the tanks about two feet above the ground. There are two such tanks. The office building is about 30 by 40 and is indicated by No. 4 on the picture. This is somewhat comparable to the foundation under the houses having a center wall throughout the building. In addition, there are some scrubbers located on the main line, not shown in the picture. These are heavy walled vessels and require a heavy foundation. The block under these scrubbers is about six feet wide and 18 feet long. No. 5 is the garage and warehouse for the station. This is a building about 24 feet wide and about 60 feet long. It carries a foundation about 10 inches thick and a concrete floor throughout the warehouse section of the building.

819 If some of these holes in the ground to which I have referred should become filled or partially filled with water and we should go off and leave the property in that condition, it would certainly attract the children across

the road and other places in the neighborhood. Counsel have advised us that it would be necessary to level off those places and fill up those holes to escape any liability from damages of that nature. This liability would continue so long as the company owned the property. As a construction engineer, it is my judgment that the figure of $3600 in the last column on page 11, which is headed "Cost to Demolish and Clear Foundations," would necessarily be expended in doing the work which I have described. This figure applies to each of the Stations 2 to 10, inclusive. On page 1 the total appears to be $32,400, while on page 11 it is $32,450; and under the caption "Cash from Salable Acreage," on page 1, line 1, Account 1000, the total salvage appears to be $3,488, while on page 11 this figure is shown at $3,538. The figures on page 1 are in error. The correct figures are shown on page 11.

At the bottom of page 11, opposite "Ottawa Warehouse Site, Illinois" is the sum of $50. This amount, in my judgment, represents the cost of clearing up one of these pipeline warehouse sites.

We worked all of these figures up in detail, so much for filling and so much for demolition. The details are shown in my working papers.

Referring to page 48, the last column, the first line shows the cost to demolish Compressor Station No. 1 of Texoma Natural Gas Company as $10,932. That particular station is shown on the picture marked Exhibit No. 92. This compressor station is practically three times the size of any on the main line. At the main building designated by figure No. 1, we have added, since this picture was taken, an extension to the building which will accommodate four more units, and the construction within this building is quite comparable with that which I have described on the main line. The auxiliary building is larger and contains larger auxiliary units.

The cooling tower has been extended, or, rather, we have built a new one altogether at the location of the cooling tower noted as figure 4 in this picture. This has extended the tower about 75 feet. The tower itself has underneath it a pit of a bigger character than those in the other stations. This station at figure 5 has an elevated water tank comparable with those on the main line. In addition we now have a new office building located just beyond the building marked 6. This is a building about 35 feet wide and 45 feet long, elevated above the ground about 3 feet. We are go-

ing to build a 200,000 barrel tank at that station. Under that tank, the foundations will be twice the bearing area at least of the ones that we have now, which should just about double their size as far as yardage is concerned. At the camp itself, shown as figure 7, we have added, since this picture was taken, ten more houses. Others are contemplated for the future. We have extended onto the garages shown in the picture and, in fact, have built a new one at the garage marked 8 in this picture. The foundations under these houses are quite comparable with those I described for the main line. We have the pipe racks and material racks located at figure 10, and these have been extended since this picture was taken. We also have a new pipeline warehouse located just beyond the warehouse shown as figure 11 in this picture. This is a warehouse comparable to the one shown and is about 30 feet wide and 40 to 45 feet long. It has an elevated concrete foundation.

820 In addition to all of the compressor station and pipeline equipment at the main line station at Pritch, we have this big gasoline plant, and all of the foundations and pits in this plant will have to be demolished and filled up. At figure 20, these absorbers have under them a block of concrete which is approximately 6 feet wide and 50 feet long, and is elevated above the ground 18 inches. They have holding-down bolts extending into this concrete to hold the absorbers against winds and other vibrations. At the right end of the absorbers is a pit about 20 feet deep, with reinforced walls, which extend above the ground line about 18 inches.

At figure 21 we have the refrigerating plant, the dehydrating plant, as some have been calling it, where we have concrete supports under heavy exchangers and reboilers. We have a building foundation at this point which is about 10 or 12 feet wide and 40 feet long.

At figure 22 there is a sump. That sump is about 30 feet square and 5 feet deep. That will have to be filled up.

At figure 19 we have the Clark engine room and the pump building. This building is about 30 feet wide and over 200 feet long now. It has been added to since this picture was taken. There are heavy concrete blocks under these engine compressors and there are heavy blocks under all of the pumps in the pump end of this building.

Referring to the distillation equipment at figure 18, we have numerous stills and fractionating towers in this area.

Also run tanks and accumulators, all of which require supporting foundations extending above the ground.

The cooling tower at figure 17 has been extended until it is probably twice the length that is shown in this picture. That would make the total length of that tower about 250 feet long. I am trying not to exaggerate these things, but that is the best of my recollection. Now this cooling tower is built quite comparable with the other cooling tower in the station and contains a pit in one end about 10 feet deep, and also numerous columns heavily reinforced to carry the cooling tower. The boiler house is a building about 40 feet wide and 60 feet long. Located in this boiler house we have a pit under one end which is 10 feet deep, the width of the building, and 25 feet long. This pit contains the water circulating pumps for the gasoline plant and other apparatus in connection with the boilers themselves. The floor of the building is elevated above the ground about two feet. In addition there are concrete foundations, bolts and so forth, under the two boilers.

At figure 16, we have the stack for the boilers, which is a concrete structure heavily reinforced and is something over 100 feet high.

At Figure 14, we have the office and laboratory which is being extended at the present time.

At figure 15, we have the gasoline plant warehouse and garage, which are quite typical of the station garages and warehouses described on the main line. When I say "main line," I mean the line of Natural Gas Pipeline Company of America.

821 The gasoline storage tanks located at figure 13 all have heavy reinforced concrete foundations under them. There are, as I recall, four walls extending lengthwise under each of the four rows of tanks. The length of these walls would be about 80 feet and the width about 12 inches, and there are a total number of 16 walls in there. In addition there is the foundation for the treating pump house, not shown on this photograph, and the foundations under the treating tanks just towards the site of the storage tanks in the picture. The tanks themselves are about 2 feet above the ground and the foundations extend around the circumference almost half of their height.

The pump house and tanks are at the rear end of the group embraced in No. 13. Surrounding this gasoline storage there is a dike which would prevent the flow of gasoline from any storage tank which broke in this area. This will

have to be leveled down. I have described the large 55,000 barrel tank, which is No. 12, and there is little to demolish or to readjust after reclaiming the tank itself. At No. 23 we have five scrubbers and we are adding now three more. These are heavy vessels to stand considerable pressure and necessarily have to have big concrete foundations under them.

The loading rack, at figure 9, will also have some concrete foundations and steel to reclaim after the loading rack itself is salvaged. It is my judgment, as a construction engineer, that it will cost at least $10,932 to demolish and clear the foundations and to fill the holes which I have described.

On page 48 is shown the cost of demolishing and clearing the Dumas warehouse site. In my judgment, this work will cost at least $50. The next item is the Kingsmill warehouse site, showing the same cost for clearing. It is practically the same type of building as the Dumas warehouse. Down below is shown the Skellytown warehouse site, with a cost to demolish of $100. The Skellytown warehouse site will contain some houses and a pipeline warehouse. It is a larger camp than either the Kingsmill or the Dumas sites and, in my judgment, it will cost at least $100 to clear it. Those last two items are property which will be added after June 1, 1939, as shown on page 48 of this exhibit.

Account No. 1002, on page 12 of Exhibit 122 shows 57 railroad crossings that will cost $250 each to replace in their original condition in accordance with the crossing contract. We have agreed to remove all of the pipeline property from the right-of-way of the railroad. This involves the removal of the pipeline itself, the casing surrounding the pipeline under the road bed, the vents which are attached to each end of the casing, and the seal between the casing and the pipeline. The hole that is underneath the railroad tracks will have to be filled and tamped in order to restore the railroad right-of-way to its original condition. The same thing is true on the Texoma railroad crossings appearing at page 49. That company has seven railroad crossings. It is my judgment that in each instance it will cost $250 per crossing to do this removal work and put the property back in the same condition that we found it.

Account 1008, refers to the telephone system and appears on page 34 for the Natural Gas Pipeline Company and
822 page 81 for Texoma Natural Gas Company. The lower half of page 34 shows the cost of reclaiming lines. The

first item reads "Beatrice to Chicago, four wires C. B. & Q. poles," showing a distance of 623.07 miles, at a cost of $55 per mile, or a total of $34,269 to reclaim those lines. It is my judgment that such an amount will necessarily be expended in that reclaiming work. The next item shows $40 per mile to do the work, and some of the other items show $25 per mile, and $55 per mile.

The cost of reclaiming this wire will be dependent upon the amount of work that is necessary in removing the wire from the poles. On the C. B. & Q. system there is a great congestion of wires and a great many cross arms, whereas on the Natural Gas Pipeline system we have four wires on a single cross arm. On the C. B. & Q. system the Natural Gas Pipeline Company does not own the poles but only the wire. Care must be taken not to damage the property of the railroad. Page 81 of the exhibit, the telephone system of Texoma Natural Gas Company, shows in the middle of the page the cost to reclaim at only $19.50 per mile as against the cost which we have shown on page 34. That is due to the amount of work that is necessary to remove the wires from the poles of the Rock Island Railroad Company. They do not have the congestion that the Burlington has on the length of line between Beatrice and Chicago. We have only two wires in the first four instances in Texas and four wires in the last line of that particular group of figures. That makes a difference in the cost of reclaiming. Down at the bottom of the page is the cost of reclaiming certain wires that will be added after June 1, 1939, at $19.50 a mile. In my judgment, it will be necessary to expend that amount in order to reclaim this wire.

Somewhere in this exhibit, I have lost the page number, is the cost to reclaim certain engines with a considerable expenditure for that reclaim work. Page 13 of Exhibit 122, where I show that it will cost $15 per ton to reclaim certain of the items at the bottom half of the page, shows that. The explanation is that I have obtained these figures through consultation with others who are to follow on certain items of reclaiming salvage. These witnesses will testify on this point.

On page 84, the eighth line from the top, appears an item of $3,500 for reclaiming 175 well meter houses. Those are small galvanized iron buildings about 6 by 9 feet, sectional buildings which have a concrete foundation under them about 8 to 10 inches high and in which the lower girth of the steel structure is buried. We will have to knock them

out and we estimate the cost of reclaim to be $20 each. That is also true as to the 197 well meter houses to be added after June 1, 1939, which is the second item from the bottom of the page.

I have obtained the information shown on page 24 concerning the cost of reclaiming the 1250 horsepower Worthington engines from other witnesses who are going to testify as to that.

On page 11, the first line shows compressor station No. 2 in Oklahoma, and the items below that under the heading "Location" show the other compressor stations and various fee properties that Natural Gas Pipeline Company owns. The second column shows the number of acres that will be salable as grazing or farm land, and the remainder, that is 22½ acres in the case of station No. 2, we consider to be ruined by the salvage operations and demolition that have gone on in clearing the site. This part of the 30 acre site will be ruined for farming and grazing purposes.

823 I am acquainted with the going prices for lands of a comparable character in the vicinity of these various stations and fee properties, and the figures I have set out represent my judgment of the going market value of that property. In the next column headed "Cash from Salable Acreage" the amount was reached by multiplying the number of acres by the market value per acre; in this instance by multiplying 7½ by $15. All the other items on that page were arrived at in the same manner.

The item entitled "Red Oak Warehouse Site, Iowa" shows 1,322 acres, and a cash value of $15. That site is on the edge of this small community, known as Red Oak. This site is not in the residential section but it is in the vicinity of the poorer dwellings of the town. It was a proper site for the erection of a warehouse in that it would not violate any of the aesthetic tastes of the people surrounding it, and it was also adjacent to a railroad. That $15 is, in my judgment, the going value of that property.

The next item is the strip on the main line in "Manon County," Iowa. That is another typographical error. It should read "Marion County." This property was purchased to prevent further coal operations in the vicinity of the pipeline. There was a strip mine operation which was approaching the location of the pipeline, and we found it advisable to purchase this 20 acres. My recollection is that that strip is 20 rods wide, or 10 rods on each side of the pipeline. It is located in an area where there is no

farming and merely grazing land. It is a rough hilly country. When these strip mining operations are completed, it will leave the land in such shape that it is useless for any agricultural purposes at all. There will not be enough coal left in the strip we have purchased to justify any further coal mining operations, and the land could not be sold for that purpose.

The next item is "Joliet Regulator Station, 2 acres," followed by the item "Joliet Meter Station, 10 acres." The salvage value for this property is included in the sale of the buildings at these sites and is shown on page 38 of the exhibit. Those buildings are of brick construction, plastered interior, transite roof and are excellent buildings. They cannot be moved economically, but we believe they have some sale value and we have included within the salvage value of the buildings at the meter station and regulator station the fee land which will be sold along with the buildings.

On page 12, Account No. 1002, under the caption "Right-of-way," no salvage value is shown. Our right-of-way grants give us the privilege of locating the pipeline on the property just so long as gas is being transported. On the cessation of operations, we will have no further rights in the property. It is simply an easement privilege granted the pipeline company by the landowner. At page 49, no salvage value is shown for the right-of-way of Texoma for the same reason. This exhibit contains no page 58 and no page 83. This is due to typing and putting the pages together.

At page 48 is shown the Compressor Station No. 1 of Texoma, which site contains 80 acres. In my opinion 60 acres of that will be ruined for farming or grazing purposes, and the remaining 20 acres can be sold for about $15 per acre, or a total of $300. The Dumas Warehouse site has 10 acres and only 2.5 acres will be salable at a
824 price of $15 per acre, netting our company $38. The Kingsmill warehouse site contains 11 acres of which 2.8 acres will be salable at $15, netting our company $42. The Skellytown warehouse site of 10 acres can be sold only to the extent of 2.5 acres at $15 per acre. At Dumas, an additional 2.6 acres will be added to the site and only .6 of an acre will be salable. This portion will sell for $15 per acre.

Cross-Examination Interposed by Mr. Slaff.

I have investigated the sales of property in the vicinity of each of these properties and I have knowledge of the going value of the property at each one of these stations. I obtained this knowledge from superintendents of these stations and know that the figures are within reason from transactions which have taken place. I have never appraised any land or real estate. (Counsel for defendant concedes that the witness is not a real estate man.)

Direct Examination Resumed by Mr. Hedrick.

On page 11, I have set out a number of particular properties. Other properties not owned at the present time will be acquired in the future but are not shown at that point for the reason that they will have no salvage value. I refer to the testimony of Mr. Strong who showed that we will have to acquire some more property on the Natural Gas Pipeline Company system. These acquisitions will be made necessary to protect the pipeline against strip coal mining operations and the same situation will obtain as to these new acquisitions as that already explained with reference to the strip we acquired in Marion County, Iowa. There are several other small properties now at meter sites and regulator sites along the main line. These sites are so small and isolated and so located that we believe they can be turned back to the farmer without cost to us. I would say these sites range from about 50 to 80 feet wide and up to 100 feet long. They are usually located in the middle of somebody's farm in the country.

Cross-Examination Interposed by Mr. Slaff.

In our figures for total salvage and for cost to reclaim thoroughout Exhibit 122, we have used labor and material prices as of June 1, 1939. I am not prepared to predict that these prices will exist at December 31, 1954. I do not profess to give an estimate of what prices will be at December 31, 1954. (Motion by Commission Counsel to strike so much of the witness' testimony as dealt with the cost of reclaiming and with salvage of property not now in existence. Ruling reserved on Motion.)

Direct Examination Resumed by Mr. Hedrick.

At page 24 of Exhibit 122, the item "48 - 1250 h.p. Wor. Hor., G. D. Compr,," the sum $88,247 was reached by multiplying the total number of tons 9,408 by $9.38 per ton. The figure shown on page 57 for the 15 - 1250 Worthington Engines was arrived at in the same way. The next line, on page 24, "19 - PIW & ADS Scrubbers," the total of $4,324 was arrived at by multiplying the number of tons, 380, by the salvage price of $11.38 per net ton. That is true as to the 5 scrubbers shown on page 57, and the other scrubbers shown on that page. The Worthington engines will sell as mixed scrap for $9.38 a ton and the scrubbers will sell as plate steel or heavy melting steel at $2 a ton more. The prices are those at Chicago, as already stated.

825 I have already stated that we used an average freight rate for the reclaim of main line material. That freight rate being $4.00, comparable to the freight rate from Station 6 at Beatrice, Nebraska. That rate was applied to all material reclaimed on the main line except at Joliet and Fritch. In addition to the freight charge we have a handling charge of $3, which includes the cost of loading into the trucks, the hauling into railroad shipping points and loading into railroad cars. That is the average cost and was applied throughout all of the reclaim exhibit, regardless of the mileage from the place of salvage to the shipping point. Most of the expenditure, of course, goes in the loading and unloading of trucks. The amount of hauling itself is very small. It will be about 5 to 7 miles on the average. The distance will not affect the cost to any appreciable extent. This $3 charge is based upon our experience in hauling up and down the line. We paid in 1935 or 1936 $5 per ton for hauling some of these Worthington engine units. We think we can haul the salvage for $3, however, because we have in mind breaking up the units into very small pieces which will be easier to handle. This will reduce the cost of hauling.

At page 57 the cost of reclaim for the 15 Worthington engines is shown at $44,688. There is a difference in the freight rate from Fritch, where the freight rate is $7.20 a ton, to Chicago. This makes the cost of reclaim of the Texoma property, which is figured on the Fritch rate, for salvage $15.20 per ton as against the $12.40 average on the Natural Gas Pipeline Company property from Gray, Oklahoma to Station No. 10. All other reclaim charges are

figured at the same rate for Texoma property at and beyond Fritch as for the main pipeline property. The $15.20 is broken down into $7.20 a ton for freight, $3 a ton for handling, and $5 a ton for demolishing or breaking up the heavy parts into smaller pieces which can be handled to advantage. Included in the figure of $116,659, shown on page 24, is a $5 demolition cost per ton, and that same demolition cost is included in the cost of reclaim on page 57 on the 15 engines shown there. This figure of $5 per ton demolition charge I have obtained through consultation with other witnesses who are to testify. The figure of $5,472, shown at page 24, is broken down into freight $4.40, the same handling charge of $3, and in cutting up this class of material we will have a demolition charge of $7 per ton, making a total cost of reclaim of $14.40 per ton.

The second item on page 57 shows the cost of reclaiming 5 scrubbers will be $1,803. This figure was reached by applying the freight rate from Fritch, $7.20, the $3 handling charge, and the same demolition charge of $7, making a total of $17.20 per ton. The difference between the cost of reclaim of the scrubbers at Fritch and the scrubbers on the line of Natural Gas Pipeline Company is accounted for by the difference in freight rates. Throughout this exhibit where any heavy melting steel appears it is given a salvage value of $11.38 per ton. Where the material is mixed scrap it is given a value of $9.38 per ton. I obtained the figure of $7 per ton for demolishing material which will have to be cut by torch, through consultation with other witnesses who will testify on that point.

826 I used the expressions "mixed scrap" and "heavy melting steel" in designating the salvage material. The difference is there is no cast iron in heavy melting steel but there is cast iron in the material classified as mixed scrap. The figures opposite the line near the bottom of page 24, referring to 9 scrubbers, 8½ tons, $97, $122, $25, and the next line showing one 5 foot by 75 foot water gasification tower, at Station 10, 135 tons, and so forth, should be reversed. The 9 scrubbers weigh 135 tons, and the gasification tower weighs 8½ tons. The figures should be reversed clear across the four columns.

At page 24 of the exhibit, the net salvage figure of $28,412 and, at page 57, the net salvage figure of $17,111 are shown in red figures; that is the cost of clearing the property. The reason this property will be salvaged under such circumstances is that we can not abandon this

equipment in place for the reasons already stated. By shipping this material to Chicago, we will derive a gross salvage of $88,247, and thus reduce the cost of salvaging the property referred to on page 24 to $28,412. The reason we can not leave this class of equipment exposed is that it would constitute an attractive nuisance if left on the foundations. It would also make it impossible to sell it along with the land still usable for agricultural purposes.

(At this point counsel produced a picture marked on the back "No. 1154, Fritch, Texas Station, 12, 24 by 36, 1250 HP Gas Engines" and requested that it be marked as an exhibit for identification. At the direction of the Examiner, the picture was marked Exhibit 123 for identification.)

Exhibit No. 123 for identification is a view of the interior of the Fritch Compressor Station at a time when there were 12 engines located at that station.

Question by the Examiner.

On the back of the picture referred to the words "Natural Gas Pipeline Company of America" have been stricken and the term "1300 horsepower" has been changed to "1250 horsepower", the real rating of these engines.

Direct Examination Resumed by Mr. Hedrick.

The equipment shown in this picture would attract all the children of the neighborhood, farm children or children from nearby communities, to play "Engineer" or what not around it. I have children of my own and I think I know what they are inclined to do. Now if they ever got into this equipment they would be exposed to all of the pits that are under the cylinders and under the flywheels. That flywheel weighs 25,000 pounds and is 15 feet in diameter. It extends above the floor line about ten feet, and the pit under the wheel is about five feet deep. There is an opening down through the engine, underneath the flywheel, which a child climbing up on top might fall down through. There is danger that a child playing on top of that engine would fall off the engine around the cylinders. The footing is very insecure at

any place where the child could stand. The cylinders are round and there are many protruding parts of the equipment. The equipment is liable to be oily and greasy. It is painted and kept in a rather polished condition. In fact some of our own men have been hurt falling off of this equipment, as familiar as they are with it. In one case a boy broke his leg. I know it is dangerous
827 enough that it has played hob with our safety record.

There is a basement underneath this building that extends from end to end and covers the viewer side of this picture, that is, over to the center columns. This basement is dark and there are low-hanging pipes. Somebody is bound to get hurt down there if they ever go down there and are not familiar with what they are doing. There are children in the small community of Fritch within sight of the Fritch plant. The population is scattered, but I would judge it to be about 500 people. Many of them are ranching people in that territory. Many of the compressor stations are situated where schools are located within sight of the station itself, and I know that there are many children passing by the plant site on their way to school. I have known of two or three instances, when I was working for the Empire Companies, where children and other persons were injured on property left in an unsafe condition. I will give you two or three instances.

While I was superintendent of a gasoline plant on a Cities Service lease known as the Bell and Dixon lease, near Okemah, Oklahoma, a lease was abandoned at the edge of this field, and the only piece of equipment left, after tearing down rigs and filling the slush pits and so forth, was a 500-barrel tank. There were several children playing in this tank, attempting to swim and enjoy themselves, and a 9-year old boy was drowned in it. They sued the company that originally owned the lease. I am familiar with another incident on the Cities Service refinery operations at Cushing, Oklahoma. The plant was abandoned and a watchman was left on the site. However, some children were playing in the yard of the site, throwing rocks in the cooling tower pond, and running around the pit. One of them slipped into what was formerly a cooling tower basis. This was quite comparable to our own cooling tower pits except it had a 45 degree sloping side. This boy attempted to get out

of this pit but the algae growth on the concrete surface prevented him from getting out and he was drowned. There was another instance that I am familiar with, which occurred on the Cities Service Gas Company's system near Hominy, Oklahoma. The company had temporarily abandoned a compressor station, and had gone so far as to board up the main buildings. The units were not entirely unlike our own. Children broke into this building after removing the boarding from the windows and were playing apparently in the building, running around it and climbing columns and what not. They found a box of dynamite caps. These are a very small article, about the size of a lead pencil eraser. They had been put away in a place where the operating men thought no one would promiscuously pick up this dangerous article. In fact, it was put up on top of a rather high cabinet, but these children found these caps and in playing with them one of them had his hand blown off. The company was sued for $3,000 in that instance. I can't tell you what the final outcome of those suits was.

I am not interested alone in what this might cost the company but I would feel that I had not fulfilled my responsibility unless these hazards had been removed because of the danger to the lives of children.

Near the top of page 13, appear a number of items shown as "Not Salvageable". The gross value that we can obtain for this pipe is $11.38 per ton, for No. 1 heavy melting steel. The average freight cost in getting this steel to Chicago would be $4.40 per ton, a figure that I have already explained. After this steel is delivered into Chicago, it will cost $4 additional to reduce this pipe to open hearth sizes. By "open hearth sizes" I mean a steel plate with a dimension 18 inches wide and 5 feet long. It cannot be sold as scrap without breaking it up in addition to cutting it in certain lengths for shipment. Pipe will have to be cut up into such dimensions that it will lay flat and be not over 18 inches wide and 5 feet along. If we add those two costs we would get a total of $8.40. Now if you deduct that cost from the price for material sold as scrap, $11.38, we would gross $2.98 delivered at Chicago. Now there are many other costs involved in salvaging that material other than the freight and the cutting into open hearth sizes. Obviously we would have to remove this pipe from the ditch. This

would cost a total of 62.8 cents per foot, or $15.14 a ton, since the pipe weighs approximately 83 pounds per foot. From these figures we reach the conclusion that it would not be at all profitable to attempt to salvage those items. On the same page there is a cost to reclaim certain gate valves of $15 per ton. We have estimated that it will cost $15 per ton to salvage all pipe material, including the gate valves and other pipe fittings referred to at the bottom of that page. We had the same hauling cost that I have already referred to, $3 per ton, and a salvaging operation cost of $12 per ton. That salvaging or reclaim cost of $12 per ton will be covered by the testimony of other witnesses in this case.

Cross-Examination Interposed by Mr. Slaff.

We included in the estimate of $15.14 per ton for cost of reclaim, the ditching, cutting into 40-foot lengths, stripping the c uplings, raising the pipe from the ditch, back filling, hau.ing and loading on cars, hauling excess dirt for the back-fill, cleaning pipe, and the labor cost in handling the pipe while cleaning, the average cost for damages, supervision, taxes and insurance. The figure is the average cost taking into consideration conditions as they exist up and down the line.

Direct Examination Resumed by Mr. Hedrick.

Referring to pages 30, 31, 65, 66 and 77 of this exhibit, the material shown in the group at the top of the page is scrap copper. It is generally insulated copper wire. That represents a salvage value of 7.5 cents per pound, or $150 per ton, for copper. The next column shows the cost to reclaim at $44 per ton. The figure should be $44.40 per ton; and in the next column where the net salvage is $1,816, or $106 per ton, the figure should be $105.60 per ton. In the preparation of the exhibit the even dollars were used instead of the cents out on the end, which will make some small difference in multiplication. The money figure is correct with the changed figure to which I have referred. I arrived at the cost to reclaim through consultation with other witnesses, who are to follow me. This cost is broken down into freight of $4.40, and 2 cents per pound for handling costs. The

latter item includes the collecting of all of this insulated copper wire and burning the insulation from it, and the haul to the railroad. That is true with reference to all of this insulated copper wire shown on the pages above mentioned. In order to sell this copper at the prices stated, it is necessary to take off the insulation and wrappings so that it can be sold as copper, the price being for pure copper.

On page 31 there is another correction. The second group of figures from the top of the page shows $279 and a total of $2,869. Those figures should be pounds instead of dollars.

829 On page 38 of this exhibit, down at the bottom of the page is a group of figures showing the cost of certain structures at Joliet. These include meter station buildings, described under that heading at a cost of $70 for the by-pass meter house; and a brick garage at a cost of $2,014; the office, laboratory and meter house, brick transite roof at a cost of $11,842; and a well house at a cost of $910. There is also shown still lower down certain regulator buildings at a total cost of $11,987. I have an opinion as to the amount which these buildings could be sold for at this time if they were of an age that they will be on December 31, 1954. This opinion is based upon my own experience in my former employment with the Empire Companies, and experience I have had in selling buildings of this particular type. These are substantial buildings. They are of brick construction and for a specific pipeline use. They are not readily adaptable to reconstruction into houses, but we feel that we will be able to sell this property for 10 percent of the costs that we have in the buildings themselves, including the 10-acre tract of land on which the buildings are located. This 10-acre tract of land has never been farmed. It is in a wooded section 4½ miles west of Joliet. There are no residences in the immediate vicinity. We had to build a private road into the property. That property is what might be ordinarily termed as scrub oak country. There are scrub oaks on that site. The soil is yellow clay but it will grow crops to some extent. Nobody has ever found it advisable to farm it. The trees on the property, I would say, are about 40 years old. The regulator site of 2 acres is a very small tract on a hill side, rather rocky. That is, the rock comes practi-

cally to the surface. We have attempted to grow a lawn on this place and have had difficulty, but it looks all right.

Referring to pages 41 and 91 of the exhibit, we show certain automative equipment showing a salvage value of 30 percent in each case. I have a judgment, based on my own experience in purchasing and selling automobiles, of which I have direct charge for defendants, as to the salvage value of the automobiles, trucks, trailers, and other automotive equipment, which these companies will have on December 31, 1954, taking into consideration the average age of the equipment at that time. Those cars will be 18 months old at the time as an average, and although we are obtaining from 40 to 60 percent of their value on trade-in for new equipment, we could not get that on a cash sale. I believe we will be able to get about 30 percent of their original cost.

On pages 34 and 81 of the exhibit are shown the telephone systems of the two companies, respectively. I have already testified as to the cost of reclaiming copper wire. The salvage value is based entirely on the 7½ cents per pound price at Chicago, which is shown as a part of the exhibit. In addition to this copper wire, there is an item of $511 shown as the salvage value of certain telephone equipment to be added after June 1, 1939. We do not believe that there is any other salvage from the telephone system than a net salvage $97,068 for the telephone system of Natural Gas Pipeline Company of America net salvage of $15,521 for that of Texoma Natural Gas Company and an additional $511 for equipment added after June 1, 1939. We have other features of construction which were given consideration, for instance the poles, the cross arms, and the pins, the insulators, the guys, and the anchors, radio equipment, repeaters, test sets, and all of this we felt had no value whatsoever on reclaim. These are light poles, 5 inches at the top, 20 feet high, and they cannot be moved. The butts will all be rotted to the point where you cannot cut the 5
830 feet off and get any salvage for a 15-foot or a 14-foot light pole of that character. The telephone poles are on the south half of the system. They are not in one place and would have to be picked up and loaded at some expense for hauling charge. The other equipment which is commonly referred to as "pole hardware" would not sell for the cost of reclaiming it. I am thinking particu-

larly of the insulators. These insulators are packed like eggs in an egg crate when we receive them and with the best of handling we break about 10 per cent of them on construction. It would be necessary to take these insulators down, many of them would be broken when we would detach them from the pins. We would have to make this arrangement for repacking them and that cost would just exceed anything that we could get out of them. The same would apply to the pole hardware, such as braces for the cross arms and the bolts that are screwed into the poles to hold those arms, and so on. Although the voice repeaters and the ringing equipment which Mr. Bulla referred to will serve our purpose, probably, until the end of the project, the chances are that there will be no resale of this class of equipment at all. They are built with radio tubes, transformers, and relayers and a lot of the small telephone equipment that we have seen on the telephone switchboards. I am sure they would be obsolete by the end of defendants' life. We own a limited number of telephone and test sets, but these will not be reclaimable and will have no value. This equipment will be from 15 to 20 years old at the end of 1954.

As to the radio equipment, we would have to find a buyer. Comparing it with existing conditions, I don't know who would buy that class of material. We have obtained a special permit to operate on a specific wave length from the Federal Communications Commission, and this equipment is not adapted to any amateur or other commercial work that I am familiar with. The radio equipment which we will have at the end of 1954 will be from 5 to 7 years old at that time.

Referring to page 16, and the breakdown on pages 17, 18, 19 and 20, those buildings and houses referred to on those pages will be sold as they exist on the property at the time. This property can be sold without reclaim cost but the buyer will come and get that property as it stands. That is true of other properties shown in the exhibit where no cost of reclaim is set out. Page 20 shows the buildings that will be added after June 1, 1939.

Questions by the Examiner.

In certain places, I have used the percentages of value based on my judgment and on consultation with other witnesses. In other places, I have used a certain money

value per unit of weight. The money value per unit of weight in determining gross revenue is a published fact and, in determining the cost of reclaim, it is in some cases my own judgment and in some cases I obtained it through consultation with others. Wherever I have used a percentage of value, or a monetary amount per unit of weight, and wherever I have used my own judgment or consulted with others, I have applied the results of those four factors to the quantity set forth in Exhibit
122 and, thus, have gotten the net salvage value as shown.

831 Information as to the production of natural gasoline under the price trend shown on Exhibit 119 is available in the statistics of the American Petroleum Institute.

The Texoma contracts with the two marketing agencies were arranged on a competitive bid basis; that is, the disposal of gasoline through Phillips Petroleum Company and Columbian Gasoline Company was on a competitive bid basis.

(At this point EXHIBIT 123 was offered and received in evidence without objection.)

832 M. E. FOSTER, a witness for defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 29, 1939.)

My name is M. E. Foster. I live in Bartlesville, Oklahoma. I am employed by the Phillips Petroleum Company, an integrated oil company.

In connection with its business, my employer manufactures and handles a commodity known as natural gasoline. I imagine we are the largest single producer of natural gasoline in the industry. This fact, I believe, is recognized by the industry. I have been with the Phillips Petroleum Company approximately sixteen years. My first position was that of a chemist in one of the natural gasoline manufacturing plants. That work lasted for a year and a half or two years, when I was transferred to the sales department, selling natural gasoline to refiners; and then, as we went into the refining business ourselves, I grew into

the job of sales manager in charge of tank car or wholesale sales of both natural gasoline and refined gasoline and also fuel oil and all other products that we sold at wholesale. I remained in that position until 1932, when I was transferred to the position I now have, which is coordinator. In my present position, I attempt to see that all the activities of the company dovetail and fit in together, to see that supplies of various raw materials that we work with are adequate and will be, planning ahead to assure adequate supplies. I work under the immediate direction of the president of the company, and my duties cover practically the entire scope of the company's activities including being interested in the purchase and handling of natural gasoline.

I do not negotiate all of the contracts, however. We have a man in one of the other departments charged with that responsibility, but in connection with assuring adequate supplies of natural gasoline, I am very much interested in the amount that we do buy and when we buy it, for what period we buy it, and I advise with him and recommend what we do and what we do not do.

I have kept up with the price tendency of natural gasoline during the period I have been with Phillips Petroleum Company. I am familiar with the history of that commodity and of the price trend. I am shown Exhibit No. 119 on which have been drawn two tracings or curves or charts, tracing by months the fluctuations in the price of natural gasoline and of what is termed as "United States motor fuel." I am familiar with the term "United States motor fuel" as well as natural gasoline.

"United States motor fuel" is a term adopted by the industry to designate motor gasoline normally sold for use in automobiles. The name was adopted from the recommendations of the government for the specifications on which the various government departments buy their motor fuel.

It appears from Exhibit 119 that during the years 1919, 1920, and for several years after that the price of natural gasoline was substantially higher than the price of United States motor fuel. That conforms with the facts as they actually existed. Natural gasoline is not a motor fuel as that term is ordinarily used. Its principal use is for
833 blending with gasoline made from crude oil to produce motor fuel. It is one of the constituent elements often entering into United States motor fuel. There were several reasons why this raw product was worth more than the

motor fuel into which it was blended. Naturally, the amount of it that was available, the supply and demand, fixed the price, but I believe probably the best explanation would be that back in those earlier days, 1919 and along there to 1922 and 1923, the refiners found that by the use of proper fractionating equipment they could cut more deeply into the crude oil and still maintain the end point specifications as set out for United States motor gasoline and increase the yield of gasoline from a barrel of crude. By so doing, even though they did not get it too heavy on the back end, the average of the gasoline produced in that way was not volatile enough to burn satisfactorily in automobiles. They could, however, buy the natural gasoline and blend with it, and build up the volatility to the point where it would burn satisfactorily as a motor fuel. They could well afford to pay a premium rather than reduce the amount of yield from a barrel of crude. By utilizing it and paying a premium for it, they were able to get more United States motor fuel out of a barrel of crude.

That is not the situation today. Back in that period, the industry had not discovered octane number. The automobile engines were of relatively low compression and fuel made in that fashion was entirely satisfactory. As the automobile industry developed, they found that they could make more efficient engines by increasing the compression ratio, and the oil industry found that gasoline made in that fashion would not work satisfactorily in these higher compression engines, so they started improving the octane number by cracking and reforming parts of the crude oil, and in more recent years even by cracking what was originally the best gasoline, the straight-run gasoline, no longer sold in very large quantities. They even put such gasoline into what is known as the reforming still for the purpose of changing the chemical structure of this gasoline to where it would have a higher octane number. In this cracking and reforming process, the refiners produced not only a gasoline that had a higher knock rating but also a more volatile gasoline, so that they found that the natural gasoline was not so essential as it had been formerly.

However, they did not discontinue using natural gasoline altogether. Natural gasoline is still produced and still used. The only difference is that now the refiners tend to use it only when they are able to buy it at a price which will afford them a profit on the use of it. One way of putting it would be to say that the situation has changed

from the days when natural gasoline brought a premium and the refiners had to have it, from what was then termed a sellers' market to what is commonly known as a buyers' market. There are other factors of course, depending on the supply of the material available and the demand for it. That fluctuates, and you can see those fluctuations there, in fluctuations in price, but the trend has been gradually downward. The circumstances that I have reviewed account for the gradual downward trend of the price of natural gasoline.

The chart shows the price for motor fuel in 1938 was lower than it was in 1937. Those prices would seem to be in somewhat constant relation there over the last four years; but the natural gasoline prices are considerably below the motor fuel prices, bearing out what I said a moment ago, that the refiners now will use the natural gasoline if they can buy it at a price at which they can make a
834 profit, but they are not obligated to purchase it, and they can make their motor fuel without the natural gasoline. They buy it now as a commodity on an exchange basis and not as a necessity. That is true in general. You understand that there are all sorts of refineries. Some operate in one way and some in another, and there may be and probably are a number of refineries today which are still buying it as a matter of necessity. There are refineries operating without cracking plants today, although they are in the minority.

What I am endeavoring to do here is to outline the trend of the industry, the vast majority of the industry. The apparent fluctuation in the price beginning about the middle or the latter part of the summer and moving up until about the holiday season or the end of the year and then dropping, which seems to be characteristic of the annual behavior of natural gasoline prices, is brought about by the fact that the natural gasoline production is for practical purposes uniform throughout the year. These plants run day after day and produce roughly the same amount every day. The demand for it, though, is not uniform. The refiners prefer to buy their natural gasoline in the fall and winter months when they can blend it with their own production to better advantage.

One major value of natural gasoline is volatility, and volatility in motor fuel is highly desirable in the fall and winter months. So there is more demand during the fall and winter months than at any other time of the year. It

is rather a perishable commodity and due to its vapor pressure, it requires special storage and rather expensive storage to store natural gasoline. As a result, very little of it is stored. It is produced and disposed of currently. That merely means that without the demand in the spring, the price reacts and goes down to where refiners will buy, then in the fall, without much reserve in storage, as the demand increases the price naturally reacts. Natural gasoline is a seasonal demand product.

Cross-Examination Interposed by Mr. Slaff.

The demand for motor fuel of course begins to fall off rather sharply in November and December. The seasonal demand for motor fuel, and the periods of the best demand for natural gasoline, while they vary for individual years, are September, October, and November. Those are the best months. You will find some years that the price carried through January in fairly good shape, in other years, it breaks off in November, depending again on the supply that is on hand and the demand, and largely on what the price of United States motor gasoline is at the same time.

Direct Examination Resumed by Mr. Morgan.

They are still using natural gasoline for such motor fuel as is being consumed during the winter months, but in less quantities because there are parts of the country that get so cold that automobiles are kept in the garage for a large part of the time. In other words, the percentage of natural gasoline used on through the winter months remains high, but the total volume is down. The production of natural gasoline does not vary seasonally as refinery production varies. So far as it is produced by natural gas companies it is a by-product, but so far as natural gasoline or casinghead gasoline plants are concerned, it is a main product with those plants. It is an incident to the pro-
835 duction of crude oil and its production varies directly with the production of crude oil. There would be substantially the same quantity of natural gasoline produced in the casinghead plants, depending on the volume of oil produced, and also from the natural gas which goes into pipelines and into carbon black, regardless of the season of the year. I concur in the view that there is a direct and

definite relationship between the price of United States motor fuel and the price of natural gasoline. The relationship is likely to continue. It is particularly true with reference to maximum natural gasoline prices. The refiners have a tendency to discontinue the purchase of natural gasoline when the price increases to the point where it approaches the value of United States motor fuel.

I stated that Phillips Petroleum Company is the largest producer of natural gasoline in this country. Phillips handles other gasoline than that which it processes itself from casinghead gas and natural gas. We purchase a large quantity in Oklahoma and Texas, including the Panhandle.

It is the usual practice and custom of those handling natural gasoline to make a brokerage charge for the handling of the product. Where the sales agency handles the sales for the manufacturer, it is customary for him to make a brokerage or sales charge to cover his expense and profit of the business. In the purchase of gasoline for our own purposes, whether it be to blend with refinery gasoline at our own refinery or to re-sell, we endeavor to buy at a differential under the posted price.

Concerning brokerage or differential, each individual contract is subject to negotiation. It depends upon the salesmanship of the buyer and seller. All sorts of different bases are used in the industry. At the time I was actively engaged in the sale of natural gasoline, I would say that the average commission in those days ran about ¼ of a cent a gallon. While I have not been so closely associated with sales in recent years, I am inclined to think that the same type of brokerage commission is still customary practice. However, I am inclined to think that it is somewhat smaller than it was then—somewhat smaller than ¼ of a cent. Although I am not directly engaged in that at this time, it is my understanding that the sales commission would certainly average ¼ of a cent.

To that the gasoline plant owner would have to add other charges that would come out of the total quantity of gasoline which he shipped to the refinery. It is customary trade practice for any outage or evaporation loss in the shipment to be charged back to the plant owner, for which, of course, he is not paid. He must also stand the freight on the outage which the customer has originally paid, but which he bills back to the producer. As natural gasoline is usually sold in North Texas or in Texas based on the Breckenridge freight rate to the Gulf, if the producer's plant is so located

that his rate to the destination is higher than the Breckenridge rate, he would have to stand the freight equalization in addition. Of course, his loading losses would be for his account, but that could hardly come in here, since we would start from the point where he loaded the gasoline in the tank car. Therefore, there are the three charges—out-
836 age, freight on outage, and freight equalization—and in my judgment, ⅛ of a cent brokerage charge prevailing at the present time.

Phillips Petroleum Company has a contract at this time with Texoma Natural Gas Company for the purchase of natural gasoline. I know about the circumstances under which that contract was negotiated, because it so happens that I was personally present in most of the negotiations of this contract. As to whether there was an allowance for brokerage in that particular instance can best be explained by stating the basis of the contract. We agreed to pay them the low market price as quoted in the trade paper, National Petroleum News. That was the renewal of the price under the former contract, or I might say, that is the customary sales price of the industry, and the only sort of commission or concession we were able to get out of this particular contract was the 2 per cent volume allowance for losses in handling. We pay them for 98 per cent of the gasoline gauged in their tanks. That contract runs until June 1, 1940.

I dealt with Mr. Davidson of the Texoma company in the renewal of that contract at its last expiration date. There were some side issues or considerations involved in the renewal of that contract. In order to secure the gasoline at the price stated, we were obliged to lease 100 tank cars at a rental of $25 a month per car for the period of the contract. That amounts to $30,000 a year. We did not want the tank cars. We wanted to put the gasoline into a pipeline system which connected to our plants and refineries, but in order to get the gasoline we had to take the tank cars, and we wanted the gasoline. It was necessary for us to take the tank cars in order to get the gasoline because there was an understanding or informal arrangement, as I understand it, between the Texoma company and the owner of the tank cars. We were told by Texoma at the time of the negotiations for the contract that such was the case. They said they had a moral obligation with this other company to sell them the gasoline. They stipulated the terms in the agreement as to the use of those

cars. (Objection and motion to strike by Commission Counsel overruled and denied.) We wanted the gasoline. Texoma told us that they had a moral obligation to this other company, which had acquired these tank cars with the understanding that Texoma would sell them this output, and Texoma was in the embarrassing position, if they sold us, of not keeping their agreement with the other company. The other company was willing to give up that part of the gasoline which Phillips bought, which was one-half of the total production of Texoma's plant, only on condition that one-half of those tank cars would be taken off their hands on a rental basis. This involved a cost to Phillips Petroleum Company of $30,000 in addition to the market price less two per cent, which Phillips agreed to pay. It is my understanding that Phillips has no use for these cars. (Objection by Commission Counsel to above testimony overruled.) We were willing to pay this rental at a cost of $30,000 a year because we wanted the gasoline. We had certain sales commitments which, together with our regular demand, necessitated the purchase of additional natural gasoline in this particular area where it was needed, and we naturally bought the gasoline on the best basis we could buy it at the time.

We have other gasoline facilities and plants of our own in the same general vicinity as the Texoma plant. We also buy from others in the same area. We are not now in the same situation with reference to a need for this gasoline that we were at the time we renewed the contract and agreed to pay this premium and the market price with only the two per cent allowance for brokerage or mar-
837 keting expense of which I have testified. We have installed transportation facilities from Oklahoma City to our Kansas City refinery whereby we can move gasoline produced in Oklahoma to our Kansas City refinery as economically as we can move it from the Panhandle area where the Texoma plant is located. (Objection by Commission Counsel overruled.) I have been hopeful that this contract would be renewed but not on the same terms. As I have testified previously, this is rather a high price to pay for natural gasoline compared to the average price prevalent in the industry. We bought it at a time when we needed it and we paid for it. If the contract was up for renewal now, we would no longer be in that position, for we think we have now achieved the desired position. It is possible by next June, which is some distance away,

that circumstances will alter so that we might even be willing to renew the contract on a more favorable basis, but in my judgment, that is extremely unlikely. By "on a more favorable basis" I meant on a basis more favorable to Texoma.

Questions by the Examiner.

I am enabled to make that statement because it is my responsibility to follow the estimates made by various operating departments with reference to future production of natural gasoline, refinery gasoline, and, in connection with those estimates of supply, the estimates of our sales department as to what quantities they will require. We are constantly planning future activities in order to be sure that we will have ample supplies of the required quantities and qualities of gasoline at the proper time in order to meet our sales commitments. We were very reluctant to renew this contract this year before we had the new facilities which we now have. We make a monthly forecast covering the next twelve months period. The last forecast made, as of the first of August, would cover the period ending July 31, 1940. That forecast covers the quantities which we will produce balanced against our estimated sales. We estimate what we have already contracted to purchase. We have definite contract commitments from a number of manufacturers which we can count on definitely as a part of our supply. This Texoma gasoline is not treated as a commitment beyond the terms of this contract. We count in this calculation only that gasoline which is firmly contracted for.

Direct Examination Resumed by Mr. Morgan.

So far as we can see today, we will not require that gasoline on the present terms by the time that contract expires.

Cross-Examination by Mr. Booth.

The principal use for natural gasoline is in connection with blending motor fuel. It is also used in blending to make aviation gasoline, or it can be used solely as an aviation gasoline without blending if the lighter end of the material be removed by fractionation. There are some other minor uses. It is sometimes used to pump down in

oil wells in an attempt to dissolve parafin accumulations. It is used rather unsafely as a cleansing fluid to take grease out of clothes, and it can be used in cigarette lighters. The principal use, as I say, is for blending to make motor fuel.

While Phillips may use the natural gasoline it buys, or sell it to others, the deduction it makes below the mar-
838 ket price is commonly called a brokerage charge because it is a concession that the gasoline plant is willing to make to avoid the necessity of organizing and maintaining a sales organization.

Cross-Examination by Mr. Slaff.

I do not believe I have testified in any other cases on similar matters. I have never testified in any other lawsuits or rate cases.

839 W. D. SMITH, a witness for the defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 29, 1939.)

My name is W. D. Smith. I live in Tulsa, Oklahoma. I am engaged in several different businesses. I am vice president of the Worthington Machinery Corporation of Oklahoma, a sales agency primarily engaged in the selling of new machinery. This company has dealt also in the buying and selling of second-hand machinery. I am vice president of the Dumar Oil & Gas Company of Shamrock, Texas, which for years engaged in the production of natural gas. I am a partner in the Gasoline Plant Construction Company of Houston, Texas, which company is engaged in the construction and operation of natural gasoline plants. I am also part owner of a small company in the vicinity of Monument, New Mexico, which is engaged in the distribution of electric energy.

I am a graduate mechanical engineer but have never engaged in the practice of engineering as such. Since leaving the university, I have been employed by the companies already mentioned, except for a period from 1923 until the end of 1926, when I was employed by the Worth-

ington Pump & Machinery Corporation of Buffalo, New York. I took a student engineering course in this plant and was later field test engineer for that company. I have never been employed by the Natural Gas Pipeline Company of America or Texoma Natural Gas Company. I have never been employed by the Standard Oil Company (New Jersey), or The Texas Company, or the Columbian Carbon Company, or the Cities Service Company.

There is no relationship between the Worthington Pump & Machinery Corporation of Buffalo and the Worthington Machinery Corporation of Oklahoma, except that the Worthington Machinery Corporation of Oklahoma is a sales agency operating in the state of Oklahoma for the sale of the products of the Worthington Pump & Machinery Corporation and of other machinery manufacturers—namely, the Hercules Motor Company of Canton, Ohio—and at times we have sold the products of other machinery manufacturers.

I am familiar with the equipment referred to here in the room yesterday and today as the Worthington compressor units. I am familiar with practically all of the machinery and equipment shown in Exhibit No. 122.

Since 1927, I have been engaged in the states of Oklahoma and Texas in the sale of new machinery and in the purchase and sale of used machinery. I helped organize a company—namely, the American Natural Gasoline Company at Shamrock, Texas—in the early part of 1934. This is in the Panhandle field near the town of Shamrock, in Wheeler County. I was one of the original organizers and was in complete charge of the building and operation of that plant for several years. The plant was shut down by order of the Railroad Commission of the State of Texas in February, 1936.

Early in the year 1937, I was instrumental in forming the corporation known as the Gasoline Plant Construction Corporation, which operated under the name of Western Supply Company for a time, although it had no connection with the Western Supply Company. This Gasoline Plant
840 Construction Corporation has built ten natural gasoline plants in Texas and Kansas during the past two and one-half years. These have all been turnkey construction contracts and I estimate about one-half of the total plants in the Mid-Continent area have been built under turnkey contracts. These plants were built for the Humble Oil & Refining Company, Cabot Carbon Black

Company, The Natural Gasoline Corporation, Southern Minerals Corporation, the Hammond Exploration Company, and Agua Dulce Company. The Gasoline Plant Construction Corporation has charge of the operation of the Natural Gasoline Corporation plant at Aransas Pass, Texas.

Cross-Examination Interposed by Mr. Slaff.

A turnkey contract is a contract whereby we as contractors undertake to design, supply the material and build the plant and then turn it over to the operator. In other words, we start with a level piece of ground, where there is nothing on it, and finish with a gasoline plant ready to operate and turn it over to the owner. We have done work both on a cost-plus basis and on a stipulated price contract.

Direct Examination Resumed by Mr. Morgan.

I am familiar with the character and cost of material that enters into natural gasoline plants and with the building and operation of such plants. I have seen the natural gasoline plant of Texoma Natural Gas Company as recently as last Wednesday. I have known about that plant for several years, in fact since the time it was built, and I saw it on one other occasion about six years ago. I went through the plant last Wednesday, viewed the equipment and ascertained the type of equipment that is used in the operation of that plant, observed the buildings on the premises, their location, their cost, their size, and other things concerning them. I have also seen the Gray compressor station in the Oklahoma Panhandle near the town of Perryton, Texas, and the meter station and regulator station near Joliet, Illinois. I did not go to the other stations north of Gray, Oklahoma and on up to Geneseo, Illinois, as I was told that the other stations are practically identical to the Gray, Oklahoma, station. I examined the station last named to see what type of equipment was utilized there and looked at the buildings to ascertain their size, their location, and so on.

The experience of Worthington Machinery Corporation of Oklahoma, and I as an officer of it, has been very poor in buying and selling used machinery. We primarily are not engaged in the buying and selling of second-hand ma-

chinery. Most of our business is in the selling of new machinery, but in the selling of new machinery we are frequently confronted by prospective buyers with taking in second-hand machinery which they have on hand. Frequently, in order to sell new machinery, we have had second-hand machinery forced on us. In other cases, we have bought some second-hand machinery as such and have resold it. We have found it very difficult to sell this second-hand or used machinery.

From the standpoint of a project like these pipelines which have constructed gathering lines in the Texas Panhandle, gas wells scattered over the Panhandle field, compressor stations at intervals of 90 or 100 miles from the Texas Panhandle up to Geneseo, Illinois, and some 950 miles of pipeline of the larger dimensions, besides the smaller pipelines, the owners would have to place their equipment in the hands of dealers or sell it to dealers who are buying and selling that type of material every
841 day in order to dispose of it, as the Texoma or Natural Gas Pipeline Company are not familiar with the markets for such equipment and machinery. This handling of used machinery and equipment is a specialized field and requires the maintaining of an organization to keep up with where there might be demands for that kind of stuff. I doubt if those who have been operating the pipeline would be in a position to know where to sell to the ultimate user that type of equipment. If the equipment was of a character that it could not be sold as used equipment, it would have to be junked and sold to the junk dealer or transported to a scrap market.

This picture, marked Exhibit No. 123, is a picture of the Fritch compressor station containing 12—1250 horsepower horizontal twin tandem gas engine compressors. These engines are approximately 46 feet long, 24 feet wide, 9 feet 4 inches high. The larger elements of these engines are the power cylinders of which there are four weighing approximately 13,000 pounds each, the main crankshaft weighing approximately 20,000 pounds, the flywheel weighing approximately 25,000 pounds, and the main frame, of which there are two, weighing 42,000 pounds each. The parts I have mentioned are all cast iron with the exception of the crankshaft. The latter, the connecting rods, bearings, and piston rods are steel, and also other parts of a smaller nature.

I had nothing to do with the sale of these units to de-

fendants. In fact, I have never sold either one of these companies any equipment or machinery. The demand for this type of equipment is in the main for trunk pipelines only. It is in very rare instances that engines of this size have been sold for any other purpose whatsoever. The manufacturing of these machines is very erratic. It is either a feast or a famine. There are years when Worthington has not built any machines at all of this size. In the case of the Panhandle gas field, they built a large number of units over a period of a very few years. My own experience while at Buffalo during the years 1923 to 1927 was that I do not recall their building a single engine of this size during that period. We have had no experience at all with buying and selling used machinery of this type. Until last night, I never heard of a single instance of such a transaction. However, Mr. Davidson informed me last night that there was a case where, when he worked for Cities Service Company, they bought three units from the Ohio Fuel Company and moved them some place from the East to the Mid-Continent. He told me, however, that these machines had only been used for a short period of time. There is only one other instance I know of where such machines have ever been taken off the foundations, dismantled and re-assembled in another location, and that was in the case of the Oklahoma Natural Gas Corporation where they moved several units from Shamrock, Oklahoma, to near Ballinger, Texas.

Being in the machinery business, we have calls all the time for various kinds of second-hand machinery. To my knowledge, my company has never had any call for engines as large as these Worthington compressor units, which were second-hand and twenty years old. These units are not stock equipment. The manufacturer builds them to special order. The engines owned by the defendants were built to special order and on special specifications. Assuming
that these engines were 20 years old, I would say
842 that they would have no value at all and I would not
give a dime for these 63 engines as far as re-assembling or dismantling them and moving them to a new location and putting them back in service again is concerned. (Objection by Commission's counsel overruled.) The only outlet would be to break them up and sell them for scrap. I have never known of a pipeline which has installed used equipment of this kind as a part of its operating machinery. There is no other use for this type of

machinery. Occasionally the manufacturer of such machines has built power engines of the same size for driving either generators or pumps. However, the cost of taking these compressor units and converting them into power units would be so much, it would not be a commercial possibility. I recall that I sold 16 engines of this same general type of a smaller size, 700 horsepower, to the Phillips Petroleum Company sometime in 1930. They now have a number of these units which are not operating and which they have tried to salvage themselves for other purposes, and at each time they have gone through the calculations of taking these compressor units and rebuilding them into power units. The cost of doing this work was more than they could buy new power units for, so they let them stand and bought new ones.

Questions by the Examiner.

We are engaged in the sale of products manufactured by the Worthington Pump & Machinery Corporation, which corporation is not connected in any way with the Oklahoma company. That was new machinery we sold to the Phillips Company but was of the same general type as that used by Texoma. The products of Worthington Pump & Machinery Corporation vary from engines of this type here, condenser engines, air compressors, gas compressors, motor driven, steam driven, centrifugal pumps, direct acting steam pumps, condensers, water feeders, a general line of machinery. I have handled that line personally in the state of Oklahoma and have actually sold machinery of all of those types. The sales of machinery in Oklahoma are naturally in large part to the oil companies and pipeline companies, including all branches of the oil and gas industry.

Direct Examination Resumed by Mr. Morgan.

I am familiar with the equipment referred to as PIW and AOS scrubbers which belong to defendants. I have seen these scrubbers at Fritch, Gray, and Joliet. I have also seen the Blaw-Knox scrubbers. I know of no salvage value for these scrubbers except as junk. They are especially built to remove the dust from the natural gas going through the pipeline and are highly specialized

equipment and I know of no other place where they could be used as such. The same is true of the 98 horsepower Casey Hedges water tube boilers, and equipment of that kind, belonging to these companies. The cost of tearing down the brick settings and moving to a new location would greatly exceed the cost of new boilers of that style and size.

I have sold lots of equipment of the type listed under Account No. 1006-E, including engines, generators, and so forth, and including the Cooper-Bessemer 175 kw. generators, the 25 horsepower motors for air compressors, and the other equipment listed on page 25 of Exhibit No. 122. It is possible that defendants could sell equipment of this type. However, bearing in mind that it will be 20 years old when it is salvaged, or when that pipeline is shut
843 down, it means that this equipment will have to be sold to a dealer. The dealer in buying it would have to remove it from its location, take it off its concrete foundations, load it on cars, and move it to his warehouse. There is not a ready market for the number of generating units listed in this account. The dealer, therefore, would have to hold them a number of years, in all probability, before he could sell them and would have to recondition the engines and generators before he could make a sale. Ordinarily a plant of this character would cost approximately $100 per kilowatt, including the foundations, the building, the generator and accessory equipment, and I feel that machines of this age would not have a salvage value of over $5 per kilowatt. It is very doubtful if a dealer in buying such a plant, would realize anything from the engines themselves. His salvage would be more on the electric equipment than it would be on the gas engines.

It is necessary to recondition that equipment, even though it was used right up to the time the pipeline ceased to do business. A dealer could not afford to take any chance with the condition of these engines. In order to satisfy himself in his relationship with a prospective customer, he would have to protect himself and tear the engines down and rebuild them, do whatever work was necessary. After he had moved this type of machinery from its location on the properties of these pipelines, paid the hauling, the freight and handling charges and costs, the reconditioning cost, and things of that kind, he might over a course of years be able to sell equipment of this age at a price not to exceed $20 per kilowatt. During the time

that he would have to keep it after reconditioning, he would have the expense of warehousing and paying taxes on the equipment. In this connection I might point out an example of a similar power plant which we purchased five or six years ago from the Carter Oil Company. This plant had three gas engine driven generating units approximately 125 kw. each. We paid $10,000 for this plant complete, including the buildings and water pumps, cooling towers, cooling coils, and everything else, and the switchboard in that plant. We reconditioned the engines but, due to their size, we did not feel like moving them from their location 100 miles from our warehouse, so we kept a watchman on the ground approximately three years. Then we finally sold this plant for $14,500 and considered ourselves very lucky to get out of the deal.

You might check back to the price per kw. We paid a greater price per kw. than is indicated here due to the fact that these were only four years old when we bought them, but even so it shows that it is very difficult to sell second-hand machinery of this type. There are very few companies that would buy it. None of the major oil companies themselves would consider the installation of second-hand equipment of this type, so we have got to go to the smaller, hardly able oil companies in order to sell it. By "hardly able oil companies" I mean companies operating on a shoestring with limited financial resources. This sort of transaction usually means that with equipment of this type, considering the type of companies you have to sell it to, you are taking a credit risk when you are finally able to make a sale, and at that time you usually have to put up with additional terms on it.

844 There are a large number of electric motors on page 25 and appearing elsewhere in this exhibit. Treating these motors as such, I feel that the salvage value of 10 per cent allowed is very high. This takes into consideration no reclaim value. The dealer would pay 10 per cent for motors which are 20 years old at their present location and then have to move them from their foundations, load them on cars, transport them to his warehouse, recondition them in some cases where the insulation would be gone, and take a chance on being able to realize not over 20 to 25 per cent of the new price of the motors after he has gone through this work. I feel, therefore, that a value of 10 per cent is more than a company could afford

to pay for such motors. The same thing would apply to all motors in this exhibit.

Referring to the item "Machine Shop Equipment" costing $24,824.43, which is given a listing of 15 per cent of cost, I know what machine shop equipment is. It consists in general of small tools, small lathes and drill presses, grinders, etc., which at times have a ready market, and I feel that a value of 15 per cent for such equipment is adequately high; that is, at its present location.

Referring to the tanks, I am familiar with that type of equipment. In general, tankage 20 years old has no value except as junk. However, I have allowed a price of 5 per cent of the original cost at its present location, which I feel is more than most dealers would give for such equipment. That applies to all tanks, except those which are too large to haul. On page 27, there are some nine 100,000-gallon elevated tanks which are immense structures and which could not be moved to a new location. They are riveted tanks. The smaller tanks, as a general rule, can be moved without tearing them down; but a large tank like a 100,000-gallon tank or a 200,000-gallon tank which has been riveted there on the ground—that is, the sheets are held together by rivets applied after the material composing the tank has been put on the ground—cannot be so moved. The only practical method of cutting down a tank of that character is to use acetylene cutting torches. It is impractical to go there and take a chisel and knock the heads of those rivets and get them out that way.

There are a large number of buildings at the Fritch plant and also a number of buildings at the Gray plant. These are structural steel buildings. The framework, trusses, and all parts are made of steel and the walls and the roof of the main compressor buildings are covered with transite, a fabricated material. The only way to dispose of buildings of that sort in large numbers is to sell them to dealers in this type of equipment. There are dealers who make it a business to go out and acquire buildings of that kind, dismantle them and then resell them. Referring to the smaller buildings, the auxiliary buildings, warehouses, garages and buildings of that type, I believe they could be salvaged for 10 per cent of their original cost on the foundations where they now are. I mean 10 per cent of the cost of the movable material. I base this on a general knowledge of buildings of this type in the Mid-Continent field, the going price of such build-

ings. These smaller buildings could be resold by a dealer to operators of natural gasoline plants; while such operators would not consider the use of second-hand machinery, they would feel that they are taking no risk in installing second-hand buildings.

845 The larger buildings, such as those which house these main compressor units and those other large buildings that I saw out there on those sites, could not be handled in this manner. There is no use for buildings of this size in the oil industry except for main gas line compressor station buildings. They would, therefore, have to be refabricated by a dealer into smaller sized buildings, and the dealer would not pay the percentage for the larger buildings that he would for the smaller ones. In all dimensions, these buildings are too large for rehandling and reassembling for ordinary commercial purposes. By "refabricating" I mean that the dealer would have to completely dismantle these buildings, move them to a shop and cut the various parts of the building into smaller sizes and then re-erect them at some new location as smaller buildings. That additional expense would cause the dealer to pay a smaller price for the larger buildings than he would for the smaller buildings. Ten per cent would be my judgment as to the small buildings and 5 per cent for the large buildings.

On page 25 of this exhibit is listed at the bottom of the page "18 C. P. Air Compressors" and "36 Dayton Dowd Centrifugal Pumps"; also, certain steam pumps, duplex pumps, and equipment of that character. This type of equipment can be overhauled and resold. However, it is my experience and the experience of others buying second-hand air compressors of this small size, centrifugal and direct-acting steam pumps, that if we were given this type of equipment free, considering its age, we could not replace the defective parts and pay the expense of hauling it from its location to our warehouse, and pay the machine shop charges and labor required to do the work, and sell it in competition with new pumps. I have had this experience in buying a large number of pumps of all sizes and types, and as a general thing it is impossible for us to recondition these pumps even though they are on our books at no cost. We have a warehouse full of them in Tulsa. We will sell them for scrap eventually. I might further add that on centrifugal pumps and direct-acting steam pumps, the cost of replacing parts

greatly exceeds the cost of the complete new pump. If you would have to buy a complete set of working parts for a pump, the cost of these parts alone exceeds the cost of the complete new pump.

I am familiar with the type of equipment known as transformers, listed on pages 30, 31, 65, 66 and 77, under Account No. 1006-I, as "Electrical Material (Exclusive of Motors)". I have sold new transformers and have purchased some second-hand transformers. These transformers will have to be sold to dealers engaged in the buying and selling of second-hand electrical equipment. Considering the fact that they will be approximately 20 years old, a dealer would not pay over 5 per cent of the original cost at their present location. That is true of all similar types of equipment; that is, similar equipment of that type listed on the various pages above enumerated.

I have studied the list of equipment shown on pages 32, 33, 67, 78 and 79 of this same Exhibit No. 122 under Account No. 1006-J, "Miscellaneous Equipment", consisting of a large number of items. I am familiar with the types of equipment that are listed under this caption with the possible exception of one or two items. I know of no dealer who handles such a wide variety of equipment as is
846 shown on those pages. It seems to me that if a dealer could be found who would buy all this wide variety of material, he would not be willing to pay much of a price for it. There are very few companies that would consider buying second-hand material of this type and the price that I have given of 10 per cent of its original cost is, in my estimation, a high percentage to allow for equipment of this age.

On page 32 are shown 6 Maihak engine indicators which cost $1,056. I own one of these indicators myself and have it in Tulsa. I have had no use for it for the last 13 or 14 years and at various times have tried to sell it for as little as $25 without success. Due to the fact that it is 12 or 13 years old, there is no buyer for such type of equipment. The equipment listed on page 68 should be included in that covered by the observations I have made concerning that listed on pages 32, etc.

I have studied the list of material under the heading "Meters and Regulators", Account 1009, shown on pages 35, 36, 37 and 82 of the same exhibit. I am familiar with that type of equipment. These meters are all of a type that are not only used in gas pipe work, but they are used

as field meters in the measurement of natural gas going to gasoline plants, and there is some market for such meters, although the larger oil companies would not consider their use. As an operator of gasoline plants, I would not install second-hand meters myself, due to the fact that I would not want to get into any squabble with the royalty owners over gas measurement, which would certainly follow if second-hand meters were installed. However, there are some companies which do move their meters around and buy second-hand meters. The price that I have allowed here of $25 a meter is the present market price of second-hand meters after they have been reconditioned and put in salable condition.

On page 35 and other pages listing the meters, I have used a price for the large meters of $25 and a lesser price for the smaller meters. It was my offhand guess that the regulators and governors shown on pages 36 and 37 would be worth 10 per cent of their original cost. This was before I visited the Joliet regulator station. After considering this matter further and visiting the site of the installation, I do not feel that these regulators would have any value as second-hand equipment. Such a type of equipment as this is very special and there is a very limited second-hand market for such equipment. Also, there have been many improvements on regulators of this type, and regulators 20 years old are, as a general thing, obsolete. It is now my judgment that those regulators at 20 years of age would have no value except as junk.

I have gone over and studied the list of miscellaneous equipment under the caption "Tools", Account 1013, appearing on pages 43 to 47, inclusive, and on pages 87, 88 and 89 of this exhibit. I have seen much of this equipment in the Fritch and Gray stations. I have indicated a 10 per cent salvage price on this equipment, which I feel is more than ample to allow for equipment of this type, since the same objections apply to this equipment as to that on the previous page, in that it could not be sold to one dealer except at a sacrifice in price. In other words, there is such a wide range of equipment listed on those pages that no one dealer could be handling all of it.

847 The equipment listed under the caption "Wood Frame Buildings" appearing on several pages of the exhibit—namely, pages 21, 56 and 84—consisting of 4-room cottages, 5-room cottages, duplex cottages, bunk houses, 5-room boarding houses, and office buildings, is listed at

$100 apiece. I have seen the houses at the Fritch and Gray stations. I am not a dealer in real estate and have never bought or sold any houses. However, my observation regarding these houses is that they are of the same general type of oil field cottage, of which there are thousands in the Texas Panhandle, which have been built since the discovery of oil and gas in th rea. In time this oil field will be exhausted and there will not only be these houses for sale, but there will be thousands of other similar houses for sale. The population will dwindle to practically nothing, the same as it was before oil and gas were discovered in this area, which is what is commonly known as the "dust bowl" of the Texas Panhandle, Oklahoma Panhandle, and western Kansas. The population, outside of the people engaged in the oil and gas business, is practically nil and is confined to those engaged in ranching and dry farming. Instead of having a salvage of $100, it would be my judgment that the company would have to stand the expense of tearing these houses down and getting rid of them, due to the fact that there will be thousands of them available at such time. I had nothing to do with the salvage value placed on those items, but I am stating my judgment about it.

The figures about which I have been testifying, dealing with the salvage values of machinery, steel buildings, and things of that kind, are largely mine. (Motion by Commission Counsel to strike testimony with respect to estimates of salvage value which have been prepared by somebody else denied.)

My testimony concerning the salvage value of the wooden frame buildings is confined to those located in the dust bowl area above mentioned. I would have no judgment at all as to what these buildings would be worth on the north end of the line. I have no knowledge of conditions there.

I have lived in the Texas Panhandle for 2½ years and I am familiar with conditions in that area. I am familiar with the equipment shown on page 22 under Account No. 1006-C, captioned "Water Well Equipment", and on page 23 is a list of equipment of the same kind to be added hereafter. As regarding the motors, the same percentage is applied here as has been applied elsewhere in the exhibit; namely, 10 per cent of the original cost at its present location. Somehow or other a price of 10 per cent

was allowed on the vertical deep well pumps. I do not know how that got into the exhibit as, in my opinion, these pumps are worthless except as junk. Vertical deep well centrifugal pumps are designed to handle a given volume of water at a certain depth through a certain sized casing and it is very doubtful whether pumps which are so special, and which have such special characteristics, could be moved to other water wells where they would be required to handle a different volume of water under different operating conditions. These pumps are operating in wells containing a certain amount of sand and at the time they are pulled for reclaim they require practically all new running parts. It would be my judgment that these pumps should be left in the wells where they now are rather than to try to salvage them for any purpose. We have been offered this type of equipment a number of times but have never purchased a vertical deep well centrifugal pump second-hand for the reasons above stated. I know of no dealer who would buy a second-hand deep well pump of this type.

848 I am familiar with the type of equipment listed on page 70, Account 1007-B, C, D, "Loading Rack, Siding and Absorbers". I see listed here an 8-car double loading rack, 265,198 pounds of railroad siding, totaling 132.6 tons, and 9 absorbers with controls. The first item, the 8-car double loading rack, is a fabricated steel rack, folded together, and has some market value. It is an item which an oil company would not object to installing second-hand because it is assumed that the steel is in good condition and could be torn down and moved to a new location. However, a double loading rack is less prevalent than single car loading racks. It is only in the larger gasoline plants, such as this, which manufacture daily a large amount of gasoline, that they require a double-car loading rack. For the average size natural gasoline plant which has about half the production of this Texoma plant, they would need a smaller loading rack. However, it can be broken down and shipped to a new location and sold. Considering its age, I have allowed a value of 10 per cent on this item. That is my judgment as to its value.

The absorbers are a questionable item. They are designed for high working pressure and are especially built to meet the needs of this gas pipeline. However, there are natural gasoline plants operating along the Gulf Coast

which would use absorbers of this high pressure and this size and I have allowed a value of $1,000 per absorber, including the small controls that are on those vessels, as a reasonable going price for such an item of equipment. I certainly feel that they would not get more than that for those absorbers.

I have had only one experience with railroad siding. That was in the case of the gasoline plant that we built at Shamrock, Texas, where we constructed a spur track on the Rock Island right-of-way. When we shut the plant down and abandoned it, we gave the spur track to the Rock Island Railroad, as we did not feel that we were justified in the expense of salvaging the equipment thereon. In other words, we felt it would cost more to salvage it than we would have been able to sell the material for as salvage.

I think I have testified on the general character of equipment listed on page 71, Account No. 1007-E, consisting of pumps, motors and engines, with the exception of the Clark gas engine driven compressors. These are small machines, smaller than the main line units, and are used in the gasoline plant at Fritch. At the present time, the market price for engines of this size which are not over 7 or 8 years old is $2,500 each, after they have been thoroughly reconditioned by a dealer engaged in the buying and selling of second-hand machines. I have allowed a value of 5 per cent of the original cost for such machines at their present location. It must be borne in mind that these engines will have to be taken off the concrete foundations, moved to the railroad, and then moved to the dealer's warehouse where he would have to recondition them and make sure they were in salable condition before he eventually made a sale. I feel that 5 per cent is ample for these items. I am not talking about these items that are going to be junked, but only of those which show no cost of reclaim and which are dealt with as salvageable equipment which can be sold on the ground to dealers for
849 resale. Those are the items which have percentages opposite them instead of per ton prices. I am not in the business of buying and selling junk, so the prices where they are given on a per ton basis, I have had nothing to do with at all.

That brings us to the "Miscellaneous Equipment—Gasoline Plant," Account No. 1007-J, shown on pages 78 and

79. This is the same general classification of material as that covered on page 32 about which I have testified. All that I have said concerning the material listed on pages 32, 33, 67 and 68 applies to all of this gasoline plant equipment listed on pages 78 and 79. I cannot conceive of anyone who has a knowledge of the machinery business allowing a higher figure than I have indicated and set out in Exhibit No. 122 for machinery and other types of equipment and materials with which I have dealt in my testimony. In my judgment, these figures represent the fair and reasonable salvage values of that equipment if it was offered for sale at present prices, assuming that it would have the age and use that it will have had by the end of 1954.

In connection with my operating a natural gasoline plant in the Panhandle for a couple of years and with my firm's operating a plant at Aransas Pass, as above stated, I have had occasion to market gasoline. We did not maintain a sales organization but have sold it to brokers in that business. The principal buyers of natural gasoline in the state of Texas are the refineries who are the ultimate purchasers. I have mentioned how it is handled through brokers, who in turn sell it to the refiners. At Shamrock, Texas, we sold our gasoline to the Warren Petroleum Company, with whom we contracted the entire output. We paid them a commission of 3/16 of a cent a gallon when the posted price was below 3 cents a gallon and ¼ of a cent a gallon when the posted price was 3 cents and above.

At Aransas Pass, we are also selling our gasoline to Warren Petroleum Company and paying them a flat quarter of a cent a gallon as brokers. The brokers' commission does not include the outage, the freight on the outage, or the freight equalization. These items are paid by the owners of the gasoline plant. So far as I know, all gasoline plants with very few exceptions pay a brokerage for the sale of their products. We have our ideas as to the future price of natural gasoline. For the past 5 years I have spent most of my time in the building and operation of natural gasoline plants. We are frequently called on by people who do not own or operate gasoline plants but who have natural gas available. They call on us to make estimates as to the cost of building and operating these plants and ask us our advice as to the pay-out of such plants. For the past three or four years, we have consistently used a price of 2-¼ cents per gallon net at the gasoline plant for

grade 26-70 natural gasoline, and it is our judgment that the price in the immediate future will not vary very much from this. My judgment is in line with that of the other witnesses who have testified that there is a definite relationship between the price of natural gasoline and the price of United States motor fuel. There is no substantial outlet for natural gasoline except to oil refiners.

I am familiar with the type of equipment listed in Account No. 1006-G and shown on pages 28, 62 and 75 of Exhibit No. 122, in which are listed material called 850 Bentube cooling sections, size C-169, and also other sizes. These cooling sections are all of the same general type and are used for gas, water and oil cooling. These Bentube sections are installed in the bottom of the cooling tower and either gas, water or oil passes through the tubes and the cooling water from the top of the tower falls on these sections and cools the medium passing through the tube. These sections are used universally in all gasoline plants. I am assuming that at the time this plant is shut down, these sections will be in workable condition and as such, I have given them a value of 5 per cent of their original cost at their present location. The dealer buying these sections would have to remove them from the cooling tower, load them on trucks and haul them to the railroad and store them someplace in his own warehouses until he has a sale for them. He might also have to replace a number of defective tubes which are of admiralty metal. The gas coils are built for high pressure and have a very limited demand.

The fact that this salvage equipment runs into sizeable numbers of particular units or a very large quantity in terms of pounds or tons makes it more difficult to dispose of it. In a number of instances in this exhibit, it is conceivable that a buyer would pay slightly more than the percentages indicated here, if buying one or two items of the type. In order to dispose of this material piece by piece, it would be necessary for defendants to go into the selling end. A buyer purchasing it all has to consider the quantity that is available and, although he might pay a slightly higher percentage for one or two items, I consider the prices indicated here are very high, considering the vast amount that is going to be available on the market.

The type of equipment in Account No. 1013, "Tools," listed on pages 43 to 47, inclusive, and on pages 87, 88 and 89, was probably acquired by these pipelines one unit at

a time, and in selling it out a dealer would have to sell it one piece at a time, or at the most just a few pieces at a time. I do not think a dealer buying all of this equipment would ever sell it all. I think the dealer would finally have to junk part of it. That is illustrative of other items shown in the inventory, especially in the case of laboratory equipment and special apparatus, thermometers and pressure gauges and equipment that is peculiar to this type of pipeline only.

The equipment called "Compressor Station Engine Parts" and "Warehouse Stocks" listed on pages 94 and 99, consists principally of the Worthington compressor parts. Assuming that the gas in the Panhandle is going to be gone, there are not only the engines involved on this one pipeline, some 60 engines, but there are half a dozen other pipelines going out of this same field. Therefore, all of these engines would be shut down and there would be no demand at all for repair parts, so that the manufacturer would not take them back even if they were new and unused, for no dealer would buy them as the engines would all be shut down. They would have to be junked and sold as ordinary scrap.

Cross-Examination by Mr. Booth.

I base my judgment as to the salvage value of the machinery and equipment on the fact that it would be about 20 years old at the time it is offered for sale. That was true as to all the equipment and machinery. The amounts stated are based on prices prevailing as of June 1, 1939. However, the valuation that I have made on most of the items is on a percentage basis rather than on a dollar basis.

It is stated as a percentage of the original cost. I should
851 not say original cost, I should say the present day cost as of June 1. I did not obtain the figures shown under the caption "Original Cost Per Unit" on page 87. They were supplied by Texoma Natural Gas Company from their books. I merely estimated the percentage of the original cost that these items would bring if they had been in service for a period of 15 or 20 years. My estimates were based on the original cost which was intended to refer to prices as of June 1, 1939. I only estimated the percentage of value. It is my understanding that the prices shown on the exhibit were the prices originally paid for the material. There might be some difference between the prices in-

dicated and the prices as of the present day. What I did here was to price the salvage in terms of a percentage of the original cost in the light of present day salvage values. I related the present salvage values to the original cost and stated it in terms of percentages. (Motion to strike by Counsel for the Illinois Commerce Commission overruled.)

Cross-Examination by Mr. Slaff.

I intended to apply these percentages to the original cost of the material as paid by these pipelines, assuming that it is of an age of 20 years or thereabouts. The reason I applied those percentages to original cost rather than to present day cost of the same material or the same equipment is that the only information available is the prices that were paid by these companies for this material, and if they were applying those percentages to the present day costs they would necessarily have to go out and get quotations. I did not inquire if the company is preparing a reproduction cost estimate. Some of this material, as far as today's market, may be of higher price, and some of it may be of lower price.

Redirect Examination by Mr. Morgan.

(August 30, 1939.)

The only prices that I had available in estimating future salvage value were the cost prices that these pipelines paid for this material, and I applied a percentage, based on my judgment as of today, to these cost prices. However, this exhibit contains two bases of prices; namely, the original cost of the material installed before June 1, 1939, and prices as of June 1, 1939, for material that will be installed after June 1, 1939. There are very few items on which I have testified that will be installed on this pipeline after June 1, 1939. The bulk of the equipment, the main machinery, is already in place and the future machinery to be installed is a very small percentage of the total. I recognize that some of this material at the time the pipeline is salvaged will be from a few years old up to 10 or 15 years old. However, the main bulk of the machinery will be approximately 20 years old, and any dealer buying all of the equipment would not go through the stations and pick out and recognize just a few items which were 5 or 10

years old instead of 20 years old, because, as I say, the main bulk of the machinery will be approximately 20 years old. In other words, a dealer dealing with the whole mass of material concerning which I have testified would treat the entire material on a lump-sum basis.

Coming back to the Worthington engines, concerning which I testified yesterday, I have since I left the stand yesterday afternoon obtained some information from the general office, for which I had been looking prior to testifying yesterday, as to the number of these engines that have been manufactured and sold in the past. I have here a list received from the Worthington Pump and Machinery Corporation of Buffalo, New York, of all the engines of this size sold since the year 1913. That organization has manufactured at least half of all of that type of large engine units sold since that year. During that 26 years, they have manufactured 250 of these big engines. All except four of them were sold to natural gas pipeline companies. Approximately ¼ of all of them belong to defendants, who own 63.

852 *Cross-Examination by Mr. Booth.*

I determined the salvage value of the meters and regulators shown on page 35 of Exhibit No. 122. I do not know the dates when all of these meters were installed. I have assumed that most of them were installed when the pipeline was built. I did not go over every meter in the system. However, in that connection, I have given a value of $25 to these meters and even though these meters were installed as late as one year ago, I still would feel that that was a fair value for these meters. That in my opinion is a high value.

I determined the salvage value of the transformers but not of the copper wire shown on page 30 of this exhibit. The salvage value was arrived at on the basis of a percentage of the original cost. My understanding of the original cost figures used throughout this exhibit, is that they were for material only and not for any labor involved in setting the equipment up. The prices are those paid by the pipeline companies at the time they purchased the material, ranging back approximately 7 or 8 years ago. I do not have the exact dates when these various pieces of equipment were purchased. It is my understanding that these are the original costs and I am considering all of this equipment as being of an age of approximately 20 years.

The figure $75.50 shown under the caption "Net Salvage" for nine 25 K. V. A. transformers, represents 5 per cent of the original cost. It represents the price a dealer would pay for equipment approximately 20 years old in the light of present-day market for such equipment. Used machinery is bought on the basis of its original cost. The buyer considers the original cost and the seller has in mind what he has paid for such material, and if the cost figures vary, for example if these transformers were bought in 1931 and they have increased in price until today, I have applied a percentage of 5 per cent to the original cost. If I were using the price of today, I would apply a lesser percentage. The percentages I have used in connection with this exhibit are all based on the original cost figures.

In figuring these percentages, I have based them on my judgment of the market as of today and have applied them to the original cost price. That is the way second-hand machinery is sold, on the basis of its original cost. The consideration that the purchaser would give to present-day prices of similar new equipment is reflected in my percentage basis. In the case of a transformer which in 1919 cost $2,000 and which, as you state, in 1939 cost $100, I would not apply the same percentage I have applied here, but would apply a zero percentage. The prices used are the original costs and the percentages arrived at according to my knowledge of present-day values and markets.

The prices used in the exhibit are the prices that the companies paid for the material, but in estimating the percentages applied to these costs, I have used the percentages based on the market for such machinery today. In other words, Mr. Booth has drawn a hypothetical example and my percentage instead of being 5 or 10 per cent on such an item—he mentioned transformers which I have given 5 per cent—it would have no percentage value at all in the light of present-day markets.

853 *Questions by the Examiner.*

In fixing my net salvage value, I used original cost, which is the cost price paid by the company, but in estimating the percentage, I had in mind the present-day market for used machinery.

Cross-Examination Resumed by Mr. Booth.

I have used an arbitrary or definite percentage in practically all cases of 5 or 10 per cent, because it was my opinion that the purchaser of the old equipment would pay 5 per cent of the original cost of the equipment if it was approximately 20 years old.

Assuming that 9-25 KVA transformers were purchased in 1930 by the Natural Gas Pipeline Company for $1,510, I have arrived at a salvage value in the amount of $75.50, by taking 5 percent of the original cost. Assuming that in 1950, when the equipment is 20 years old, the cost new of similar equipment instead of being $1,510, is $15,010, a prospective purchaser would pay 5 percent of the $1,510.

If you assume, as you state, that the transformers cost the company $1,510 in 1930 and could be purchased new in 1954 for $150, the percentages would have to be varied then in the light of markets in 1954. I have based my percentages in the light of the market as it exists today and that percentage is related to the original cost, but the basis of the percentage is in the light of what the market is today for second-hand machinery.

Cross-Examination by Mr. Slaff.

When we go to buy a second-hand transformer, we determine the price that was paid at the time it was purchased, say 10 years ago. The seller has in mind the price that he has paid for the equipment; in every instance, when I am buying second-hand material, I first make an investigation to determine what the original cost of that material was in the year in which it was purchased by the seller; in machinery of this kind it is all tagged with serial numbers, and it is very simple to go to the manufacturers and get the specifications and the year in which it was manufactured. Most of the material of the nature in this exhibit is owned by the major oil companies and gas pipeline companies. They have very complete records of their material and specifications upon which they purchased it, and we can usually get their purchase orders and check the specifications and prices. So in that case we do not feel that it is necessary to go back to the manufacturer and find out what this company has purchased in the first place. However, this material sometimes moves around and some other company may have acquired it and maybe that company would

not have the complete record. In that case, we would go back to the manufacturer and find out just what we were buying.

This material is of such a special nature that the average person looking at it cannot tell the specifications and how it was built in the first place, and we want to know what we are buying. So in order to determine the original cost, we go either to the books of the seller and take the original cost from the books, or else to the manufacturer and get the cost to the seller from the manufacturer. It is not necessary in all cases to go through that procedure. We know in the case of some of this material what the market is and what the net prices for this second-hand material are, regardless of going through the original cost and applying the percentages as related to present-day markets. We know the market, at least we think we do, for machinery of all ages. The market is based on the original cost, allowing for conditions as they exist at the time. There is a wide variation in cost, say, in two different years. For example, there was a wide variation in general price levels in 1920 and 1921, or in 1921 and 1922. Prices went up to a great peak point after the war and then dropped sharply. If there is a wide difference in original cost of equipment purchased in 1921 and equipment purchased in 1922 of exactly the same type, the same wide variation of cost is carried into the second-hand market for that material or equipment in 1939.

854 *Redirect Examination by Mr. Morgan.*

By my last statement, I meant that when one of these sellers has a lot of material of this kind to sell, he makes a list of it before going to seek a buyer and attaches to that list invariably what it cost him, so the buyer has the figures of original cost when the seller gets to him in the first instance. As a rule, the material list is so marked and in the event it is not marked, we ask the seller what he paid for it. We fix the percentages in the light of the present-day conditions or the present market for used material. There is a relationsihp between the market for new material of the same kind and the price the dealer in used material will pay for it as used material. That is what I mean when I say I take into account the marketing conditions as at the present time. When we take these into account, regardless of whether the seller bought in 1921 or 1922, we apply the

percentage to what he paid for it that the present market justifies, and that is what I meant by saying that it is based on the original cost as a practical proposition.

Cross-Examination by Mr. Slaff.

The price we can get for used material today determines what we will pay for it, and the price that the purchaser will pay us for it depends, as far as he is concerned, on the relationship between the value of second-hand material and equipment and new material and equipment.

Redirect Examination by Mr. Morgan.

With the percentages stated in the exhibit, 5 or 10 or 15 per cent, I have used all three of these percentages, I have taken into account that very relationship about which Mr. Slaff was speaking. As of today, I feel that those percentages are proper percentages to apply. They might not have been the same percentages three years ago or they might not be the same in 1954.

855 G. M. DAVIDSON, recalled for defendants, testified as follows:

Direct Examination by Mr. Hedrick.

(August 30, 1939.)

In order to straighten out the record and make it perfectly clear where the prices shown in Exhibit No. 122 for materials purchased prior to June 1, 1931, were obtained, I wish to explain that they were taken from the books of the company. As to the materials which have been purchased or are to be purchased after June 1, 1939, where prices are shown for them, I secured these prices from the exhibits submitted by Mr. Strong, Mr. W. H. Davidson, Mr. Powers, Mr. Bulla, Mr. Campbell, Mr. Bussard, Mr. Dickinson and myself.

On pages 13, 15 and 54 of this exhibit there are certain items where the words "Not Salvageable" as on page 13, and "No Salvage" as on pages 15, 53 and 54 appear. There are other items of property of both defendants which are not shown at all in this exhibit and which are not salvage-

able, according to information from other witnesses who will follow me on the witness stand and testify concerning those items. In the light of this information and of my own experience, it is my judgment that the items not listed are not salvageable. I have prepared a list by account number classifications, such as 1002, etc., showing additional non-salvageable property of the two companies. When this list of non-salvageable property goes into the record, it and Exhibit No. 122 and that property concerning which I have already testified as being non-salvageable, will include all of the property now owned by these two companies and all that will be added thereto which will be on hand as of the end of 1954. Of course, in addition to these properties there are the gas leases of Texoma which will automatically expire when there is no further production. We have no fee interest in these leases. They are somewhat like the right-of-way easements, in that when the use ceases the right in the property ceases as I understand it.

(At this point the witness produced certain lists of property entitled "Natural Gas Pipeline Company of America —Non-salvageable Property Not Listed in Exhibit No. 122" and "Texoma Natural Gas Company, Non-salvageable Property Not Listed in Exhibit No. 122." The Examiner thereupon instructed the reporter to set forth in the record the items contained in such lists as follows:

856 Natural Gas Pipeline Company of America

Non-Salvageable Property Not Listed in Exhibit #122

Account Number	Description
1002	Telephone System Right-of-way Easements.
	Various Land Easements at Stations for Drainage, etc.
1005	Road Markers and Stiles.
	Steel Frame and Corrugated Iron Gate and Header Boxes.
	Concrete Foundations Meter and Regulator Stations(150 Yards).
	Blocking on Main Line Headers, etc. (Concrete 300 Yards).
	Ottawa and Red Oak Warehouse Foundations (235 Yards).

Account Number	Description
	Insulation on Meter Runs—Ottawa, Illinois.
	Insulation on Regulator Runs—Joliet, Illinois.
	Gaskets, Bolts.
	Scattered Pipe Racks.
	Jetty Protection on Rivers.
	Drain Tile Used on Farms as Replacement.
	All 24-inch Main Line Couplings Including Welding Coupling Sleeves.
	All Pipe and Casing at Railroad Crossings.
	Linewalker Bridges Scattered along Line.
1006	Engine and Building Foundations, Floors and Reinforcing Steel.
	Pipe Rack Foundations.
	Blow-off Pits (Concrete).
	Cooling Towers and Cooling Tower Basins (Concrete) and Guy Wires.
	Concrete Septic Tanks.
	Sidewalks and Lighting Fixture Foundations.
	Manifold Blocking (Concrete).
	Fences, Gates and Cattle Guards.
	Roads and Curbs.
857	Evaporation Ponds.
	Landscaping and Shrubbery.
	Recreational Facilities.
	Insulation on Steam Lines.
	Signs, Steel Stairways and Grating.
	Water Wells and Original Casing (All Excepting Mechanical Equipment).
	Miscellaneous Plumbing Fixtures in the Stations.
	Grating in Floors.
	Lighting Fixtures, Conduit and Globes.
	Annealing Furnaces.
	Sewer Lines.
	Storage Batteries.
	Clothes Line Poles and Wire at Cottages.
	Small Oil Measuring Tanks.
1010	Signs, Walks and Roadway—Red Oak Warehouse.
	Lockers—Red Oak Warehouse.
	Fencing—Various Meter and Regulator Sites.
	Retaining Wall (15.2 Yards Concrete)—Davenport Line.

Account Number	Description
	Curbs, Sidewalks, Roads, Sewerage System Signs—Joliet Meter Station.
	Water System and Landscaping—Joliet Meter Station.
	Curb, Walks, Landscaping Sign—Joliet Regulator Station.
	Pipe Racks, Roads, Signs, Lockers—Ottawa Warehouse Site.

Texoma Natural Gas Company

Non-Salvageable Property Not Listed in Exhibit #122

Account Number	Description
1002	Telephone System Right-of-Way Easements.
1004	24", 18" & 16" Pipe, Valves & Fittings and 24" Couplings.
858	Concrete Anchors on 24" Pipe.
	Cattle Guard, Gates.
	Various Types of Drips and Headers.
	28" Highway and Railroad Crossing Casing.
	Approximately 200 Yards of Concrete in Building Foundations.
1005	All Main Line Couplings, Including Welding Sleeves over Couplings.
	All Main Line Meter Headers.
	All 28" Casing Pipe Railroad and Highway Crossings.
	Concrete Anchors on Main Line.
	Pipe Racks.
1006	Engine and Building Foundations, Floors and Reinforcing Steel.
	Pipe Rack Foundations.
	Cooling Towers and Cooling Tower Basins (Concrete) and Guy Wires.
	Concrete Septic Tanks.
	Sidewalks and Lighting Fixture Foundations.
	Manifold Blocking (Concrete).
	Fences, Gates and Cattle Guards.
	Roads and Curbs.

Account Number	Description
	Landscaping and Shrubbery.
	Recreational Facilities.
	Insulation on Steam Lines.
	Signs, Steel Stairways and Grating.
	Miscellaneous Plumbing Fixtures in the Station.
	Grating in Floors.
	Lighting Fixtures, Conduit and Globes.
	Annealing Furnace.
	Sewer Lines.
	Storage Batteries.
	Clothes Line Poles and Wire at Cottages.
	Small Oil Measuring Tanks.
859	Gasoline Service Equipment.
1007	Concrete Blow-off Pit.
	Building Foundation and Floors.
	2 Air-Cooled Settings for 500 H.P. Water Tube Boilers.
	200' Reinforced Concrete Chimney.
	Concrete Walks and Curbs.
	Evaporation Pond and Pits.
	Miscellaneous Plumbing Equipment.
	Miscellaneous Shelving and Cabinets.
	Steel Grating and Steps.
	Concrete Foundation of Material Storage Platform.
	Concrete Foundation of Pipe Rack.
	Concrete Septic Tank.
	Absorber and other Tank and Tower Foundations.
	Foundations on Chlorine Rack.
	Ice Making Equipment.
	Salt Storage Tanks.
	Insulation of Piping and Various Equipment.
	Lighting Fixtures, Conduit, Globes.
1010	Curbs, Roads, Sidewalks.
	Cabinets, Clothes Lines, Shelving.
	Cattle Guards and Pipe Rack Foundations.
	Foundation for Storage Platform.
	Corrugated Iron Tool House and Garage and Wood Frame Water Well House, Kingsmill.
	Concrete Septic Tanks.
	Water Wells.)

860 *Cross-Examination by Mr. Booth.*

The amounts shown under the caption "Original Cost" on page 22 of Exhibit 122 represent the cost which the company paid for that equipment when it was purchased. The cost of the motor itself is the amount stated. I went to the books and got the figures shown in this exhibit, that is, I had my organization do so, and in that connection I instructed them to obtain the book cost figures for the material which is to be salvaged. The freight is not included in the items shown in this exhibit. Only the bare cost of the items as shown on the books is shown throughout the exhibit. I would like to make one explanation in this connection. Some of the buildings, the main buildings for instance, were purchased erected. Now in that case, freight and labor of erecting were included in the purchase price and reflected in the original cost shown by the books.

The amounts shown under the caption "Original Cost" on page 27 relating to tanks represent only the cost of the equipment, as to all those small tanks. There is a question in my mind as to the elevated storage tanks. I believe that those tanks were purchased erected, but that is immaterial since those tanks are not affected by the figures shown under the column "Original Cost", as they are among the items to be salvaged on a weight basis. I am speaking here of the nine 100,000-gallon tanks, weighing 212.66 tons.

Cross-Examination by Mr. Slaff.

Whenever freight was paid by the company it is not included in the original cost figures, and no other overhead and no interest during construction or expenses of that type are included in such figures, only bare original cost; only the amounts received by the seller from the defendants are reflected. (Objection and motion to strike by counsel for Illinois Commerce Commission overruled and denied.)

861 HERMAN P. TAUBMAN, a witness for the defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 30, 1939.)

My name is Herman P. Taubman. I live at Dallas, Texas, where I have lived since the early part of 1938. Prior to that time I lived for eighteen years in Tulsa, Oklahoma.

Before going to Tulsa I was employed by a junk and salvage company in Joplin, Missouri, for four years from 1916 to 1920. This company was the Joplin Iron and Metal Company. It was engaged in buying mining machinery and breaking it up, that is, any part of it that could not be resold. We also engaged in the resale of second-hand mining equipment. They were considered the largest dealers in their line in the Southwest. They bought and broke up large crushers and compressors and the engines that supplied the power for the plants. These plants were mining plants that extracted zinc and lead from the ore, or rather from the boulders brought up from the ground. These boulders were crushed up into what we call tailings or gravel for the separation of minerals. They employed heavy machinery in these operations.

When I went to Tulsa I entered the oil and gas supply business, mainly in connection with the pipelines, buying and selling of pipelines and abandoned leases, oil and gas wells that were exhausted, and putting the material on the market for sale as salvage. I went to Tulsa in 1920. I started with a strictly second-hand business in pipe and machinery, but later I specialized in pipe alone, and machinery was a side line. For a period of three years we had given no specialty to either pipe or machinery, depending on whatever came our way. At the end of three years we changed our policy and specialized in pipe because we felt that machinery, no matter where it was located, in all instances had to be brought into the plant at great expense. It had to be overhauled, tested, and sold with a guarantee of performance. We had a great deal of it come back on us because parts which would not be reconditioned would give out afterwards. In other words,

making good on the items we sold cost us too much, and we finally had to quit dealing in such machinery.

Thereafter we handled it only on the basis that when the pipeline or lease was offered us for sale and we could buy it and figure the machinery and equipment on a junk basis, so that we could break it up and ship to the nearest market, we took it. Otherwise we refrained from purchasing some of it if we had to sell it as usable items.

My business continued strictly second-hand until the early part of 1926. Thereafter we found that the market for second-hand pipe was getting more difficult, due to the newer types of pipe and the greater capacities of the steel mills, which made the sale of second-hand pipe material and its turn-over difficult. We had to add new pipe
862 in order to remain in business. In 1926 our business was divided between second-hand and new material about half and half. The second-hand business kept going down until the three years at the height of the depression when of course there was very little business, if any, and at that time the second-hand business was practically the same as the new. In normal times, after the depression lifted somewhat and business improved, in 1936, when I sold my business to Bethlehem Steel Corporation, 85% of my business was in new material and about 15% second-hand.

I operated the business about one year for the Bethlehem Supply Corporation, a subsidiary of Bethlehem Steel Corporation. There was a reason for this decreasing percentage of second-hand business down through the year 1937. The constant increasing cost of labor and the improvement of new material rendered second-hand pipe impractical because of the ratio of saving in the price we had to charge for second-hand pipe, that is worked over and shipped later for a specific purpose, in relation to new pipe. The prices were so close that the buyers did not consider the second-hand pipe. We get a greater number of buyers for the smaller sizes of pipe, such as 12 inches in diameter and under, than for the larger sizes.

I am familiar with the type of pipe as to dimensions and specifications used in the construction of the pipeline of defendants. I bid on a great deal of it, although I did not get the sale of it. I had the specifications to bid on and made bids in an effort to sell these companies pipe at the time they were constructing their line. Included in my

pipe business, of course, were pipe fittings, such as gate valves, fittings, and accessories that go with pipelines.

Since I withdrew from the pipe business at Tulsa the first of 1938, I have been in the oil business. I have had oil interests for about eight years, of which I did not have personal charge. On leaving the supply company I took charge of my oil company, known as the Buffalo Oil Company, which is engaged in drilling wells for oil and gas.

I am conversant with oil field conditions down in the Southwest in the States of Oklahoma and Texas. I know the types of pipe that are being utilized, and I know the demand for pipe of different dimensions and qualities, as well as some of the machinery that is employed by pipeline companies. I spent over a million dollars for purchases of this nature of material in the last three years. From the beginning of 1921 I have kept a record of the pipe and machinery and related material which I handled. The volume amounted to more than $36,000,000. I have bought thousands of miles of pipeline in the ground and taken it up and put it in condition to sell as used pipe. This was not at one time, of course, but in the aggregate of years that I was in the business. The cost of taking pipe out of the ground and incurring all the expenses incident to getting that pipe loaded on the cars varies as to locations, as to depths, and as to weather conditions in working outside. It ran from $15 to $18 a ton.

These costs include a number of items. First it is necessary to get permission from the land owners to enter their property, and in most instances they make you pay considerable damages because they figure that when you get the line out of there, that is the last chance they will have to get anything from it. We find we have to pay a considerable amount more than was paid in the origi-
863 nal taking of the right-of-way from the owner. We find the farmers in a receptive mood to find damages for turned up crops, dead cows, and everything, and we have to pay them these damages even before they let us come in with our property.

Then we have to remove the pipe from the ground. Some smaller pipe we ditch by hand, by shovels, but in the larger sizes we have to use heavy machinery, such as tractors, ditchers, and cranes to lift the pipe on heavy trucks. We first have to ditch it, to uncover it, to get to the pipe. Then we have a crowd of men with shovels

following to get to the pipe itself to get it free to be lifted. We then lift it up with a crane. If it is small pipe, we put men in there and let them shoulder it out. Even up to 6-inch pipe we handle it by hand, but when it gets above that we have to have cranes.

The equipment we use depends on the size of the pipe and the weight of the load we have to lift. We cut it with acetylene torches usually. This is an expensive operation. We have to have skilled men for the job, and the ingredients of carbon and all other requirements that go with the mixture in the acetylene, and the equipment itself is quite expensive, running into quite a cost. After we get the pipe on the ground we have to cut it in lengths to transport over highways in approximately 40-foot lengths and get it away from the ditch. Then we have to refill the ditch made in recovering the pipe. If the pipe is a large size, we naturally create an empty space there where the pipe is taken away, and if the land is flat it is necessary to fill it up and restore the ground in a usable condition to the farmer, whatever that condition happens to be. The specifications in the right-of-way grants require that the pipe be buried enough below the ground to make it safe.

Referring to the pipeline of the defendants, the places that I have looked at, even as late as two weeks ago, aside from knowing the specifications at the time the pipe was laid, I noted that the pipe is buried an average of five feet—some places may be four and some six, but the general average I would judge to be five feet in depth to the top of the pipe. I was really curious, and at the time I noticed the depth I inquired of the management why they went so deep, and they explained it was a high pressure line and they had to bury it deep to have the safety factor of the weight of the soil to hold it down.

In order to get the dirt off the pipe and get it out of the ground, it would be necessary to have regular ditching machines such as were used in putting the pipe down in the first place. They can come within an inch or so of the top of the pipe without hurting the machinery. Later it is necessary to follow with men and shovels to dig at least one-third of the clearance down the sides of the pipe so we can have it free enough and loose enough to lift it out of the ditch. In other words, it is a pick

and shovel operation to get the dirt immediately off the top of the pipe and one-third down the sides.

When the pipe is lifted out of the ground by heavy machinery, as I have stated, it having occupied a cylindrical position there 24 inches in diameter, there will not be enough dirt there to fill the ditch back to its level at the time the salvaging was started. There is no dirt, I would say, in the majority of the territory without making a ditch by bringing it in from the sides. If we get the dirt along the pipeline immediately near the pipeline and fill the trench, we create a ditch condition. It is necessary, therefore, in order to satisfy the farmer
864 to haul in dirt to level the place where the line was taken up, or it would be necessary to leave a ditch even if you take dirt off the sides and try to level it up. In most instances we allow for the ground to settle, due to rains and washouts, so that we would not have to come back and repair the right-of-way, because we are always subject to damages for going in and breaking up the land. We build a ridge above the trench so as to allow for the ground to settle to a level.

If the pipeline happens to be on a farm under cultivation, the farmer definitely will not let you take the top soil off his cultivated field to fill up this ditch. It is necessary to bring the dirt from the outside, and the dirt left on the top of the field must be as near as possible the same type of dirt he has there. In other words, he will not let you bring in any rock and gravel and road building material to fill in with because that would ruin his land. He wants to go on cultivating after the pipeline is removed and requires some soil that will conform as near as possible to the soil on the rest of his land. If the land is not restored to approximately its original condition, it means more damages than the damages alone of going in there with your machinery in the first place. You never hear the end of it unless he is satisfied. I have had lawsuits to pay for months after we lifted the pipeline. In one case the farmer even accepted the backfill when we left. He said, "It looks all right to me." Some months later we found he had a cow that got hurt, that broke its neck. He said the rains came that he did not expect and washed it out. Unless you leave the right-of-way in a safe condition, you are responsible for any damages that may result therefrom.

When we have got the pipeline on the ground cut up into 40-foot lengths, we have to lift it up from where it is and take it to the nearest railroad point for shipping. If it is coated pipe, a pipe that is coated with bitumastic covering, we have got to take it off. Bitumastic covering is a pipeline coating for its protection. If you are going to sell it for pipe, you have to clean it off so the man who is buying it would know what he is getting. He would not buy it like a cat in a sack. He would want to know the condition of the pipe before he bought it, and you would have to take this covering off. You would have to get special machinery because this type of coating is a sort of enamel. It cannot be handled by hand. There is machinery in existence for that purpose. It cannot be removed with sandpaper like varnish or paint off of furniture or off of wood, unless you wanted to be there for the rest of your life. If you want to take it off economically, you have to use machinery for it. That is an expensive operation. It is big pipe, weighing 83 pounds per foot, and a 40-foot length would make it over a ton, and you have to have a crane or machinery erected at each loading point, or you have to have an army of men carrying that pipe, and in either instance it is an expensive operation.

For the removal of this enamel the pipe must be moved to a location flat and dry, and this is usually at the railroad. In my judgment there is not enough ground in the country where the pipeline could be taken that would accommodate that much pipe. It runs into too much stack space alongside the railroad. Unless you have an immediate outlet where you could move it out of the way, I doubt that there is any one point on the entire line that you could get enough space to stack this pipe and work it over and lay it away for later shipment.

865 In order to get it to the railroad for cleaning it has to be trucked with heavy trucks. It cannot be trucked as ordinary material, such as the smaller items concerning which Mr. Smith and Mr. Davidson were testifying here yesterday. It is necessary to have heavy pipe trailer trucks to handle this type of pipe. That type of truck usually has what we call a winch, or else you have to use a lot of labor, unless you have a crane. You can hardly use a crane in the loading because the crane would have to be on the other side of the ditch, you know, and it would just

be impossible. It would be necessary to use a lot of manpower and skids to roll it up on. This loading and trucking would cost between $3.50 and $5 a ton, depending on the distance.

After it has been taken to the railroad site where the cleaning machinery is located, there is other cost involved in getting it on the railroad car ready for shipping. The cost depends on what you are going to ship it for. Before you can ship it, if it is to be used after cleaning it off, it would be necessary that it be again coated with what you call an iron paint protector. Otherwise the pipe would become rusted and would not be merchantable. That is necessary if you are going to dispose of it as used pipe. In addition to that, the ends must be beveled for welding, because in cutting it at the ditch it is practically impossible to make an accurate cut so both ends will meet again when you are relaying it, and therefore you have to go over it again and trim the ends suitable for rewelding, what we call beveling for rewelding.

Pipe that has been bent in going over hills and across valleys and around curves and things of that kind it would be definitely impossible to straighten out and make a merchantable job of it without its costing more than making new pipe. That pipe could not be cleaned off with the some machinery with which straight pipe is cleaned off. You can only accommodate straight pipe traveling over rollers, pipe that fits the machine. It must be straight or it would not go through the rollers. This bent pipe would not be fit to use if you cleaned it by some other method.

After getting this 24-inch pipe out of the ditch and paying the farmer his damages and meeting his requirements as to refill and so forth, and after trucking it to the railroad and cleaning this pipe of its enamel, such of it as is straight, and after rebeveling it and preparing it for welding again, the pipe is then ready to be loaded on the railroad car. Since it is exceptionally heavy and is built for a specific purpose, my experiences have been that we have never bought or sold any amount of it worth mentioning of this size of pipe in such weights as that, or, in fact, very little in any weight of that size, because it is an unusual size for oil and gas use. I have had very little experience in handling 24-inch pipe in my business down there. I purchased about a mile of it from the A. O. Smith Corporation in Milwaukee, Wisconsin. They had it left over from an order that they filled and had it in stock for three or

four years, having no calls for it. They had to have space when they went into the manufacture of casing, and they asked me if I would buy it with other sizes of large diameter pipe. I bought, as I recall, close to 1,000 tons in all, of which the 24-inch was about 200 tons, or a mile in aggregate length. Well I held it there. I moved it from where they had it and paid for the moving in order to get it out of the way. They had sold it at a low figure because they wanted to get rid of it, and the understanding was that I would move it. So I moved it to the lower end of their plant, and finally, after a year nearly, they got tired of looking at it and called on me to remove it.

866 I shipped it to Houston. It happened that I had more space to spare there at that time. I held it there nearly a year and had to clean it again before it was merchantable. Finally I sold it to the Humble Oil and Refining Company for a gasoline plant where they wanted some low pressure pipe. The specifications I think were 22 inches, but I gave them 24 inches at the same price at the low weight figure in order to move it. In other words, there was a job where they could have used 22-inch specification work, but the larger size in this particular instance did not interfere, and they were getting heavier pipe for the same money as light pipe. It took me two years to get rid of a mile of pipe which I bought new at a second-hand price because the manufacturer wanted to get rid of it. I don't suppose I would live long enough to get rid of 900 miles of pipe of this character.

Taking into account this cost of removing the pipe and getting it to the railroad, which I have stated would be from $15 to $18 a ton—and in my judgment it will cost that to get it there, I am basing that on the cost of small sizes, with less difficulty, with less equipment used. I am not raising the figure. It could be done with a safety factor in this size of pipe. My reason for saying that is because the heavy weight involved in the pipe would be offset by the greater tonnage taken up in a day's work with the same crew that would take up small sizes, and therefore I am not using a higher figure, which should be allowed based on the extremely large size of the pipe, the extremely heavy weight in handling.

In my eighteen years in the pipe business I would say that for the first ten years I do not recollect having a single call for 24-inch pipe, and for later years, when the greater number of gasoline plants began to be built with what we

call a low intake pressure, we got occasionally calls for 20-inch and some 22-inch and once in a great while 24-inch for extremely light weight pipe. There are manufacturers who make that pipe. That is not the same type of pipe that went into defendants' pipelines. They do not require the same specifications for this low pressure use out at the fields for the gathering of gas to a natural gasoline plant that are required by these pipelines in transporting gas under high pressure. As I recall, it is 50 pounds of pressure going into the line, and what we call a stovepipe weight would be sufficient, and that is what they asked for.

I do not remember ever having had a call for used pipe of the specifications of the pipe used by these pipelines. There is a market for 16-inch and smaller light weight pipe used in the construction of gasoline plants, but there would be no market for this heavy 24-inch and 22-inch pipe. In my judgment second-hand pipe would not be used, even if there was a line of this type of pipe contemplated being built elsewhere. In fact, I have never had an inquiry for a permanent high pressure line where they would take second-hand pipe. This is for the reason that the life of the pipe, based upon metallurgical figures, would not justify the expenditure of constructing the line at this great expense, having in mind that the pipe would not last during the same life that new pipe would. There is a lot of expense involved in the laying of a pipeline besides the purchase price of pipe. A pipeline would only be constructed by people of financial means, and under no circumstances would an engineer specify or even accept at any price a line of this type after twenty years' use, regardless of the looks of it.

867 The only market disposition that could be made of the steel in these pipes would be a market for such use as road crossings and use for such gasoline plants as might be built where they could use light weight pipe. In such competition, even if there was a fair market for this heavy pipe, taking it out and preparing it for use and shipping it to the point it might be used at, in some instances would be local shipment, but assuming it was carloads, the freight from the point where most of this line is located is almost as high a rate as it would be from the steel mills, and in some instances a greater freight rate, because the ordinary railroad points do not have what we call a common point freight rate for pipe and equipment such as to compete with the steel mill must be set up. Therefore, it would cost

you more to send this pipe to where it might be used than new pipe from the mill that is made to the specifications, which would be just as acceptable for other purposes as this heavy weight pipe. In fact, it would be more suitable because in constructing lines in the field which are usually short they do not equip themselves with the type of equipment that would be required in a line of this type. Naturally, since it is extremely heavy pipe, it would not be as suitable for that purpose because they would have extra expense in laying it.

In other words, my judgment is that from an economic standpoint, it would be utterly impossible to condition and market this pipe within a reasonable length of time.

We have overlooked one factor, and that is the tax. The minute we take the pipe out of the ground and bring it to the railroad station we find the tax assessors counting the joints of pipe and sending us a bill for it. I have had an instance where I took out a line and brought it to the railroad point in Oklahoma in Pawnee County. We came in early in February to move the pipe and there was a sheriff's notice: "Do not touch this until you pay." I think it was three hundred and some odd dollars for tax. So our counsel went over there, and they told him that anything that was in that county since January 1st, if it was unloaded, would be taxed. He said, "You pay me for a whole year or I will not let you take the pipe." We had to pay before we could move the pipe. In taxing the pipe he values it alongside the railroad and not in the ground.

In addition to the slowness of its moving and the tax, there is the safety standpoint of children getting on this pipe and getting hurt. All that would cost more than you could get out of it. The only practical solution from an economical standpoint would be to take this pipe up and ship it to the Chicago junk market and sell it to the steel mills for melting back into steel. In order to do that this bitumastic covering would have to be removed since it contains a chemical which would be injurious in the melting of steel, and no steel mill to my knowledge will accept it as scrap steel for remelting until that is removed.

Then you would have to pay the freight rate to Chicago. You get it into the yards in 40-foot lengths in pipe of these dimensions. It would then have to be moved into some yard which is equipped to get this pipe into specification melting sizes for steel scrap. This unit is called cupola size. This refers to the cupola in which the steel is remelted, and they

have to cut it into slabs 18 inches wide and 5 feet long to accommodate open hearth furnaces. No steel mill would take it in 40-foot lengths. It would have to go to a dealer's yard, wherever you could find one that is equipped for it, in Chicago or other markets. Naturally, the closer to 868 the shipping point, the more you would reduce the freight. In my days we were forced to use acetylene torches to cut this pipe into these small cupola sizes. I understand now they could build a machine if there was much tonnage involved, whereby they could flatten it in one operation and then cut it with the machine, thereby reducing it to $4 a ton. Cutting it by torch would cost about $7 a ton. The prices quoted in the publications and shown in this Exhibit 122 are the mill prices quoted in the Chicago Journal of Commerce and the Iron Age that we used to go by. There were three or four such publications. That is the market at which the steel mill would be interested in buying this pipe or these chunks of pipe for melting purposes. The record shows that at the present time the price would be about $11.38 a ton. Instead of making money salvaging this pipe and putting it in shape to sell to the steel mill, you would lose about $13 a ton on it.

The cost of bringing it to the railroad would amount to at least $15, the cost of cleaning it to $2, and assuming the place that you break it up will be near the steel mill, the freight, I understand it, would be on the average of $4.40 a ton. This would bring the cost of getting it to Chicago up to $21.40. The cost of cutting it into cupola lengths would be another $4 a ton, bringing the total cost up to $25.40. This would show a loss of $14.02 a ton. As a practical proposition, it is impossible to recover that pipe economically. My judgment would be, if your right-of-way terms would permit it, to leave it in the ground. That is the only salvation without going through a tremendous loss.

As to river crossings, our practice has always been to leave the steel there. The costs were always greater than the material was ever worth after recovering it. I never heard of any one's salvaging a river crossing. Those that we did do we never told anybody about them. By river crossing I mean the river line, the pipeline across rivers and streams. The line headers would be obsolete and there would be no market for them as used equipment. They would not be worth anything to take down for the money they would bring as scrap. The gate valves were specially

made for this purpose, and there is no market whatever for any other use. If you have to leave the pipe in the ground, you would leave those in the ground because they would not bring the price for junk that it would cost you to take them out.

In Exhibit 122 all types of gathering line pipe and fittings, including valves and other fittings that go with the pipe, outside of the 24-inch line are valued at $20 a ton. I gave Mr. Davidson that figure. It is based on purchases which have been made for about ten years of similar grades of material which were in rough condition coming out of the ground. It is not possible to clean up, recondition, and resell for further use all of the equipment of this kind that comes out of the ground when a pipeline is salvaged. None of it is suitable for immediate reuse without work cleaning up, testing and replacement. In the case of gate valves, you would have to bring them into a machine shop, take them apart, replace the parts that are worn, reseat the rings, and later test it again for whatever use you are going to put it to. In doing so the percentage of at least one-third is usually discarded as not being suitable for working over. Not until you perform considerable work and incur considerable expense can you determine whether it is suitable or not. We go through with the work and expense of taking it up and hauling it to the train, and shipping it to the central places before we find that out in many instances.

The same observation applies to the pipe. It isn't
869 suitable to be used immediately without being taken into a central point, cleaned up, checked and tested, and the ends rebeveled for welding, and whatever percentage isn't suitable for reuse has to be discarded as junk.

Bent pipe of 12 inches or less in size can be straightened if the body is sound and in usable condition, but this straightening involves a cost, depending on the size of the pipe and the amount of bends or kinks to be taken out. There is regular machinery, similar to the cleaning machine, only it operates with a hydraulic press, which is used in the straightening process. It is a hydraulic system, whichever way it operates, whether by hand or motor, and the pipe is put in the straightener, and there is a half round shoe that comes down on the pipe in the crooked places to straighten it. Light weight pipe, 12 inches down, can be straightened cold. Heavy weight pipe has to be heated either with building a fire from wood, or a torch has to be applied before you can straighten it. In other words, the

strength of the pipe is so great that if you force it with hydraulic jacks without softening the metal, it would throw the pipe out of roundness and render it worthless. In order to maintain its roundness you have got to soften the metal, make it flexible, so that it will straighten out.

It is seldom that you are able to recondition and sell more than 60% of the pipe that comes out of the ground. That doesn't mean that all of that is what you would call 100% good, suitable pipe for the same purpose. It would do for a lighter use purpose than it was originally intended for.

There is a corresponding loss by unfitness for further use in other types of these fittings besides the pipe itself and the valves that I have mentioned. There are many reasons for this. For example, most of them are made out of cast iron, and they will be chipped off and defaced in appearance, in addition to the worn parts, and there is a great deal of obsolescence. A certain pipe is made for a specific purpose and would not be suitable for many other purposes. For gas line use I would say 95% of the pipe used is welded together. Taking welded pipe and cutting it into 40-foot lengths in the manner I have stated here in order to be able to handle it, there is loss in the cutting process and in the reconditioning or beveling of the end where the cut is. That is true even if the pipe came out sound from the standpoint of its condition. The weld originally made to lay the line seldom is cut right in the weld. You always cut a distance from it, leaving on one end of the pipe that part which has been previously welded, and in order to make it merchantable and suitable for reuse, that part has to be cut off and beveled for use again, and there is a loss of about 5 percent of the metal.

This taking up of pipe and pipe fittings of the various kinds that are listed in this exhibit and reconditioning them for sale as used pipe and fittings is a specialized business. There are quite a number of people in the business, but they all have to have equipment and central points to bring the material to and work it over.

In an instance like the Phillips Petroleum Company, or any other company which is continuing to operate in the field, they will take up lines and sort them out and do the same work as the dealers do. They will then pick out what they can use and bring it to such points as it may be
870 suitable for, and they do not sell that unless it is a tremendous amount more than they need. The same

people, however, do sell, and I brought many millions dollars worth from major units which do use the same kind of material in their operations, either the operations for which the material was originally intended or any other branch of the industry, but by reason of the freight factor and the handling, they will at times sell. I happened to buy a gasoline plant and the lines from Phillips in Roswell, New Mexico. They at the same time were doing work in Kansas. It would have been entirely prohibitive from a cost standpoint for them to take this particular plant and move it over to Kansas, so they bought new material and some second-hand material I had to sell there. They sold me the New Mexico stuff as it stood. They turned it over to me, and I took it out of the ground, cleared the location and shipped it where I had a market for it.

In other words, some of the oil companies which have this type of equipment which they can move within limits from one place to another build up organizations for the purpose of doing the same thing that the dealer in second-hand material of this kind has to do. They have a man in charge of that particular department that uses the same machinery we do and goes through all of that. Of late, if I am permitted to state, I have investigated personally among the oil companies and dealers and find that they are discarding this practice by reason of the fact that it is unprofitable to maintain any central point for shipping material to, and handling and labor and freight are eating up the worth of the material compared with what they can buy new material for as and when they need it.

Even those companies like Phillips Petroleum Company, which have built up organizations and have acquired equipment necessary to recondition pipe and pipe fittings of this character do not recondition the material but sell it to a dealer who is equipped to do that. This dealer must know its condition before he sells it. I would say that in a case where the Natural Gas Pipeline Company and the Texoma went out of business after the gas gave out, they would definitely have to sell it to some one who is in the business, because economically it would not be possible for them to organize such type of organization to do this work and carry on the sales for the length of time that would be involved to get rid of it. I am talking about these gathering lines and pipe fittings that go with the gathering lines, which are listed here in the exhibit, the small pipe and small

pipe fittings of the character listed here, on which I have placed a $20 valuation. This valuation covers this type of material after it is taken up and put on a car and I had a chance to see what I am getting. I would not pay that kind of price for the material in the ground and take it out. The fact of the matter is, based on today's conditions in the market, I wouldn't take it as a gift in the ground where it is now.

I heard Mr. Davidson testify that in applying the arithmetic which is used in making up Exhibit 122 he had applied a freight factor of $4.40 a ton from all points up and down the line except Joliet, which is near Chicago, and Fritch, which is down in Texas, and in those two instances he used a freight cost of $1.06 and $7.20 respectively, and that he had used a hauling charge of $3, and that the balance of the cost involved in the reclaim was to cover what he termed "demolition." I supplied those figures to
871 Mr. Davidson for this exhibit, based on my experience of demolishing engines and pumps and tanks and scrubbers, and material of that type, perhaps not as big as those, particularly the big compressors that are described here, but for a similar nature of work. By demolition I mean breaking them up into parts that can be handled as junk and sold as junk at the full market price. We use three levels of demolition: $7 in the case of what he termed melting steel; $5 for these large units and other units composed of what he termed fixed scrap; and $2 for some of the small castings which can be demolished with a sledge hammer without the use of heavy equipment. I supplied those figures.

In order to demolish a 100,000-gallon or 200,000-gallon water tank set up on stilts and cut it into cupola sized pieces, we generally have a group of men around there to keep every one out of the way, and then we apply the acetylene torches to the props or legs that hold up the tank. We manage to knock it down to the ground and then apply the torch in cutting it up. We have to cut it with a welding torch which burns its way through the steel. Steel products cannot be broken up with dynamite or a sledge hammer. We have to use a torch on them. If you start shooting a steel plate you will get killed. You might, in light weight steel, make a hole in it, but the idea of dynamite breaking is not only to break an immediate spot, but it is the amount of cracking it does to the whole structure. It will not crack steel. The acetylene torch is the accepted way of cutting

down these large steel units into cupola sized pieces so that they can be sold as scrap.

You have to use skilled men who know how to operate torches. My experience is that this process involves a cost of from $7 to $10 a ton, depending on the size of what you are breaking up and cutting up and the thickness of the metal you are working on. The same type of torch is used as that used putting it together by an acetylene weld, only you use the tip of the torch for welding and the other part is used for cutting. The same ingredients are used, and practically the same type of training for the men is required in either operation. These torches require skilled men who know how to operate them.

When we come to one of these big compressor units we find that the shaft is steel, the piston is steel, and probably the lettering around it, and some of the supports. The remainder is casting. The castings are usually so heavy, that is, the majority of them are so heavy, that you can't use a sledge hammer on them, and to get anywhere with it you will have to apply dynamite. The steel shafts and other steel parts you will have to use the torch on. That same performance applies to that type of salvage as it does to the tanks and the scrubbers. We find that the cheapest method and the quickest method to demolish big cast iron engines or crushers or pumps, or whatever they happen to be, when they are too heavy for sledge hammer work, is by the application of powder, just the same as you use dynamite in dynamiting rock or anything else. That is not the safest way, but it can be done, and that is the way we have been doing it. It requires skilled men for the purpose, who know how to handle powder and who use judgment as to loading, so that it won't fly in every direction. I tried it myself and had several narrow escapes until I learned how.

872 *Questions by the Examiner.*

In order to apply dynamite to castings you find a flat spot on the metal so it won't roll off, something that you have a hold on, and you apply the amount of sticks of dynamite you think it will take to do the job, and fix it with a fuse and cap, making the fuse long enough to give you a chance to run away from it. Then you pack mud or wet ground, preferably a mixture of something that will hold, on the top. It doesn't have to be a big load, and if you

taper it with something on the top it has a tendency to shoot downward, whereas if you place the shot right on top of the metal without anything on it, it will fly in all directions, and there is no telling where it will land.

Direct Examination Resumed by Mr. Morgan.

For an engine of the size of one of those involved here, you have to make quite a number of shots, because it is a large engine, and you don't expect that to blow up all at once unless you use a ton of dynamite, and then you wouldn't find anybody around there. Quite often we make shots and they don't take effect, and we have to do it over, or they don't break through, and we have to do it over.

Due to the heavy parts there is so much weight in it, we have found in our experience that it would run from $5 to $7 a ton, based considerably on how far you have to transport your men and if you have to board your men. If you have facilities locally, it reduces your cost. Where you have to bring them all in and take them back and feed them, that naturally brings up the cost. In this case, where your lines are located, in my examination recently, I didn't find a place where you would have for the men to do the work. You would have to bring them from somewhere and take them back.

Occasionally you find the type of men who are trained in this sort of thing and who are skilled in handling dynamite and these acetylene torches, and equipment of that kind, in the localities where these compressor stations up and down the pipeline are situated. But most of them you have to organize and bring in and give them a regular set-up to go on the job. It doesn't necessarily require that all of the men you use be skilled. You probably use on a job like this maybe 30 or 40 men, and you wouldn't need over a half dozen trained men. The rest of them can be ordinary laborers to do the work.

The small castings, water pumps, and things of that kind can be broken up with a sledge hammer, and each man can break from two to three tons a day, and maybe four. It depends on the place he works in and how accessible he is to the work. A man could swing a hammer all day long and break, as I say, from two to four tons. I figure to pay a man like that out in our part of the country about $4 a day as a common laborer. But you have insurance to carry,

and you have to feed the men and bring them in, and so if he averages three tons a day he costs you $6 at least, and thereby I arrive at the figure of $2 per ton. That is in line with my experience in junking that kind of machinery. Those other figures of $5 and $7 are in line with my experience also. In all these figures I tried to use the lowest figures in our experience, because there is to be considered that this will be a big job, and you can organize crews to go on these jobs that would reduce your costs to some extent, compared with your costs if you have just got to pick up a man here and there; for quite often you d n't
873 get the right kind of men to do the work. In my judgment these are the minimum costs, and if any additional tax, such as Social Security and any other tax, may be added to the labor cost, that, of course, would raise these figures.

In the course of my experience going out and buying pipelines and pipeline fittings and other equipment, in which I dealt for a number of years, as I have stated, I have run into wooden cottages such as you see in the compressor station sites of these pipelines. In every instance there are from one to ten houses. In the nature of the business you have to provide permanent families with a place to live at the work. I didn't make a specialty in dealing with this type of equipment, but there was always that type of material, or I called it part of the salvage problem which we found in every deal when we could buy a "clean-up." I mean by that that we had to buy the whole place as it stood, including houses, offices, and garages. Such cottages have always been furnished and always will be as long as the companies have to provide permanent quarters for their men.

In our work, of course, we have had quite a number of leases or plants that we demolished in a district where other plants in other business enterprises were going on. In other words, it wasn't a district where everybody was moving, but was a going district like the Panhandle is today. We found occasional buyers, like a farmer who wanted a better house, or maybe there would be a small town nearby, and if the houses were in shape, they would buy them and move them over to the town, doing considerable repairs to the house. There never was a ready market for them. It has always been one of the things we didn't give a great deal of value to when we were figuring on the plant. We have sold them all the way from $25 up to $100,

depending on the condition of the house and the location and the outlet we had for them. Sometimes we found it cheaper, rather than to leave a nuisance and be subject to damage suits, to put gasoline on it and burn it down, and in that way we would be better off. In most instances we found that the plant was located on leased ground, and the lease reverted back to the original landowner, and we used to make a deal, on my clean-up jobs, with the landowner for cleaning up certain parts of the work, and we would hire him to do that in order to get along with him. We would figure a house in for a little amount, plus whatever additional cash we had to give him, to clean up the location acceptable to him from the standpoint of the restoration of the ground.

I gave each of the houses, including 4-room cottages, 5-room cottages, duplex cottages, bunk houses, 5-room boarding houses, and office buildings a listing of $100. This is the most that I would figure any one would get for them, having as many of those houses. I gave them this value only because they are well built houses, and I am assuming that they will keep them up in good shape to the last minute. As far as the market in the Panhandle is concerned, as I know it, having a branch there for eleven years, frankly I don't know what to do with them, no matter what kind of structure they are. Sometimes a little community starts when the plant is built, and when the plant is moved, the whole thing moves because there is nothing else for them to live on. In that particular country, which has been the dust bowl that we know it to be, whole communities are isolated and the houses are boarded up and left standing there. I don't know what they will do with them. It is a shame. I was ashamed to figure a house as good as these at any figure less than $100.

874 Most of the people who live in that country live from employment in the plants built down there. They earn their living from the operation of the oil and gas companies and other industries which are dependent on these companies, such as gasoline plants, refineries, carbon black plants, machine shops, and other things that have to do directly with the oil and gas business. When the plant is gone, in a case where the company continues to function in business, they pick out some employees and move them to new locations, and those that they have no use for they turn loose, and they drift in every direction. They don't have a chance for livelihood where they are.

Cross-Examination by Mr. Slaff.

I have never testified in any other case on matters similar to those to which I have testified here.

875 E. M. SOLOW, a witness for the defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 30, 1939)

My name is E. M. Solow. I live in Dallas, Texas, where I have lived between six and seven years. For two or three years prior to that I divided my time between Pampa, Texas, and Tulsa, Oklahoma. Pampa is in the Panhandle of Texas, in Gray County. It is the county seat of that county. It is within what is commonly known as the Panhandle Oil and Gas Field.

I am Vice-President of the Western Supply Company, an organization engaged in the purchase and sale of oil field equipment, both new and second-hand. I have been associated with that company for the past ten years. For five years prior to that I owned a business of my own engaged in second-hand trading of oil field equipment, under the name of Solow Pipe and Supply Company.

The Western Supply Company has a store at Pampa. In connection with that store we have a machine shop and a shop where valves are reground and refaced and reconditioned so that they can be resold. We also have at that point a pipe shop where used pipe is brought in and reconditioned for sale.

At Greggton, in the East Texas field, we have a store and also maintain a pipe shop. At Wichita Falls, in North Texas, we have a supply store where we maintain a full line of casing, line pipe, and supplies. At Tulsa we have a large machine shop, rather completely equipped, where we can manufacture various oil field specialties, repair and recondition pipe, and things of that kind. These are all the places of business we maintain at the present time.

During the period when I lived part time at Pampa and part time at Tulsa I was engaged exclusively in the second-hand material business. To put the thing briefly, we trade in any kind of second-hand oil field equipment where we feel we have a chance of making a dollar. That means we

will take oil field leases that have been abandoned, pull the equipment out of those, and salvage it. We take up pipelines and salvage the lines. We will buy warehouse stocks of valves and fittings and other equipment of that kind and divide them up among our stores. If they are used material, we will send them to our shops and recondition them. We are engaged really in a general used material oil field trade.

Oftentimes we have had to acquire residences or wood frame cottages provided for employees when we buy leases on which these structures are located, and we just get rid of them as best we can. We buy whatever they have if we think there is a chance to make any money on it. Oftentimes what these oil companies want to do when they sell a property is to clean the thing up completely. They want you to take possession and charge of it and clean up everything on it that is to be cleaned up, and turn the property back to the landowner in a condition suitable to him. That is the usual practice.

876 When an oil or gas well is drilled there remains in it certain casing, consisting of steel pipe screwed together in joints to comprise a wall for the well. If the well is drilled by the rotary method, which is one of the two general methods of drilling wells, there usually is a small amount of surface pipe, 100 to 300 feet, cemented from top to bottom in the top of the well, and then there is a final string which shuts off all formations above the gas or oil which is being produced from that well.

Wells drilled by the cable tool method, on the other hand, often start with larger strings of casings, and as salt water or other obstructions are encountered as that well is drilled, additional strings of casing are set from time to time. A cable tool well may have in it four or five strings of casing. When it is completed only the bottom string shuts off the last water or other formation which would interfere with the production of oil or gas from the well.

The two principal elements entering into the cost of the well, which this record shows ranges from $17,000 to $22,000 in the Texas Panhandle, depending on whether it is drilled in the Gray-Carson or Moore County areas, are the cost of making the hole and the cost of equipping the hole. When you drill a well you employ usually a drilling contractor who, for so much a vertical foot, does certain things. He sets the pipe, cements the pipe, drills the hole, and hands over the well in complete condition with the forma-

tion drilled under the instruction of the company's supervision. That usually represents about 70% of the cost of drilling gas wells in the Panhandle. The remainder of the cost is the cost of the material, principally the casing, which is placed in these wells. In the case of gas wells it is almost exclusively casing, and on top of these gas wells is placed a Christmas tree containing two or three gate valves and nipples.

When a gas well has served its purpose and ceases to produce gas in quantities justifying the owner's operating it, that 70% which the owner paid to the contractor is gone. There is nothing there but a hole which has to be filled up and plugged in accordance with the rules and regulations of the Railroad Commission of Texas, if the well happens to be in Texas.

When the final string of casing is set in a rotary drilled hole, it is cemented in place. The casing as first placed is merely hung in the well which has been made by the drilling contractor, and there is no seat, but in order to retain that casing in place and prevent leakage around the casing, it is cemented. This fills up behind the casing up to an approximate depth of, say, 1,000 feet, and is an additional wall to the casing up to that point. When you pull pipe out of a well you can't pull the cemented portion of the pipe.

The man who goes in there to pull this pipe moves his hydraulic jacks on to that pipe and takes tension, or stretches and measures the pipe. If the pipe is loose, say to the top of the cement, it will stretch eight or ten inches. If it is tied up where it can't be pulled one or two joints down, there will be practically no stretch. If he can only get four or five hundred feet, he will only have one and a half or two inches of stretch.

877 In the Panhandle there is a formation known commonly as salt. It is a formation that goes clear through the Panhandle from one end to the other. In Gray, Hutchinson, and Carson Counties you will encounter that at depths of 1200 to 1500 feet, depending on your well location. In Moore County, which is farther west, it will be found 100 or 150 feet deeper than in adjacent counties. That salt formation, when water leaks down into it, evidently ties that pipe up like cement, because it is practically impossible to get pipe out below that salt, and that salt is above the bottom of the cemented portion of the string.

In considering the salvage from these wells you have to look to this salt. I would say that the maximum amount of

pipe you could expect to recover from one of these wells, taking the Texoma wells as a whole, is 1200 feet, but you don't always get the maximum amount of pipe. In many cases you get much less.

When I was in Amarillo last week a friend of mine, Don Harrington of the firm of Hagy, Harrington and Marsh, told me that they had recently drilled a gas well south of White Deer. It was such a small well they decided to pull the casing out, but they didn't get a single joint, when it had been in the well only a few days. In our own salvage operations we have had similar experiences.

So it is an entirely uncertain thing as to how much pipe you can really get, but for the purposes of this study I have estimated that we will recover 75% of the pipe above the salt, and frankly, I think that is a very generous amount to estimate. That is about 800 feet of pipe per well.

Ordinarily when you have pipe to pull from a well, you will employ contractors who are engaged in that business and who have the special equipment that is necessary, consisting principally of heavy hydraulic equipment to pull this pipe. Usually these contractors gamble in pulling pipe by taking a job on shares, but I have talked to every contractor in the Panhandle or have had our representatives up there talking to these men who are in the pulling business, and they confirm my judgment that no contractor would, or would have a right to, risk pulling these rotary drilled holes on shares, because there is only one string of pipe in them, and the amount of recovery expected is so little that it would practically cost them all or more than they could get out of that salvaged pipe to move in and do the job.

When the Texoma drilled these wells at each location there was a slush pit, which was built by the contractor, where he mixed his mud. When a well is plugged you have to fill that well with a mud-laden fluid sufficiently heavy to suit the requirements of the Railroad Commission. Usually this mud is taken from the old slush pit at the side of the abandoned well, but in this case there is no slush pit there. Texoma cleared that ground off as level as the top of this table. I drove around to I don't know how many of these wells, maybe fifty of them, all over the field, and I didn't see one evidence of a slush pit at any of those locations. They cleared them off after the wells were drilled. The contractors used them in making the well, but they cleared

them off, I presume to avoid damage to cattle on the ranches in the Panhandle where these wells are located.

878 Now a contractor will have to haul mud and water and fuel oil to these locations. These contractors want various prices for doing this work. They range from $32 to $50 per 8-hour tour. After they find out how much tension they have on the pipe, they have to shoot off the pipe above the point where they estimate it will come, that is where it will start pulling out of the well.

In order to shoot off a piece of pipe 800 feet under the ground they have to drop dynamite in the hole, and sometimes it won't work and they will have to come up another 100 feet and shoot again. We have shot wells from a depth of 3500 feet to the top without the pipe coming loose and pulling. In other words, there is no question at all but what the actual cost to the pulling contractor for pulling the pipe out of these rotary wells will be $500, $600, or $700 per well.

Now in valuing the salvage of these wells in this report I gave Mr. Davidson this $100 figure. I allowed $100 for salvage for those rotary gas wells. I think it is an overstatement, and I put it in there because I believe it was a case where there were so many wells that there was a possibility that you might work out a little better trade with a pulling contractor and might get a small amount of salvage out of these wells.

There is one other factor I ought to describe, and that is the value of this pipe that is recovered from the wells. These wells are equipped, with one or two exceptions, with 8⅝ inch casing. This casing is either lapweld, electric weld, or seamless. Some of it is 28 pounds and some of it 32 pounds. I averaged the present new prices of all that material, and it figures about $1.55 per foot for the average value at this time of a joint of casing in one of these rotary wells. A second-hand dealer doing business and buying second-hand pipe would not pay at this time 77 cents, which is half the new price of 8-inch casing, but I have given that much credit for the pipe.

Now to haul that pipe from these locations, which are an average distance from the railroad of six or seven miles, and to ship this pipe from the Panhandle, because the oil and gas field will be abandoned when this system is abandoned, to a Texas common point, which is the cheapest place to which pipe can be shipped, will cost, reduced in terms of footage, 16 cents a foot. So that the value of this

pipe to the Texoma for salvage would be 16 cents less than the 50% price I have indicated, or 61 cents a foot, and the value of 800 feet of this pipe would be approximately $489. If it is going to cost $500 or more to pull and plug the well and supervise the plugging of it, and furnish the cement for the plugging, the dynamite for shooting, and everything else that has to be done, you can see that there is no real salvage to these wells.

There is a difference in the salvage situation of those wells drilled and completed by the rotary method and those which are drilled and completed by the old method of using cable tools. These cable tool wells have all the way from two to four strings of casing in them. I took the first 15 of these cable tool wells listed on the material reports of the Texoma and found that in these 15 wells there were 879 the following pipe: 973 feet of 20-inch pipe; 4,509 feet of 15½-inch pipe; 6,956 feet of 12½-inch pipe; 16,529 feet of 10-inch pipe; 19,325 feet of 8¼-inch pipe; and 7,471 feet of 6⅝-inch pipe. This pipe is not cemented in the wells as the pipe I described in the rotary wells was, and you can recover a percentage of the surface pipe. I have been buying wells in the Panhandle for ten or twelve years or longer. We have drilled a number of wells out there. We have had experience pulling this pipe, and before I wrote these figures down I made two trips out there. I discussed it with the members of our organization and with our man in the Panhandle that does all the preliminary dealings in pulling wells and things of that kind, and I believe the figures that I am going to give you now for recovery are exactly in line with conditions as they will be found.

I estimate that we will recover 30% of the 20-inch and 15½-inch casing; 50% of the 12½-inch and 10-inch casing;—this is the pipe where the salt will be behind one of those strings—60% of the 8¼-inch and 6⅝-inch casing. The reason, of course, you will recover more of the latter strings is that they are protected to the depth to which the outside strings are set.

Wells of this kind are the kind of wells that pulling contractors will contract to pull and salvage for 50% of the salvage. It is usually a good thing to deal with them on that basis. They naturally want to get all the salvage they can and will make every effort to get every foot possible of it out because their profit and the success of their work depends on their ability to get a good measure of pipe recovery.

Using these figures of recovery which I have given you, we will recover 292 feet of 20-inch pipe; 1,353 feet of 15½-inch pipe; 3,478 feet of 12½-inch pipe; 8,264 feet of 10-inch pipe; 11,595 feet of 8¼-inch pipe; 4,483 feet of 6⅝-inch pipe.

This pipe will have to be handled similarly to the pipe pulled from the rotary holes. It will have to be hauled from these locations, transported to a dealer's yard at a Texas common point. In addition to that, this pipe will have to be repaired. Cable tool wells are drilled with the tools hanging down on a wire line or cable, and the tools flop around in the hole, and oftentimes they line-cut, that is, the side of the line whips a groove in the pipe. There is some cut pipe in nearly every cable tool hole, and that has to be discarded. Further than that, a good deal of this pipe in these cable tool holes will have to be repaired in machine shops. Defective threads will have to be replaced with good threads. Swelled or damaged collars will have to be taken off and replaced with new collars. We have estimated the cost of shopping and throwing out junk pipe at $5 per ton. I think that is very reasonable. In actual practice the allowance for that is usually substantially more than I have given you.

In addition to that there will be a 2% loss in shopping pipe. In other words, when you cut off a thread to put a new one on, when you cut off a collar to put a new one on, when you have a joint of pipe that has been shot off and there is a shot hole in it, and you cut 6 or 8 feet off that so as to cut a new thread, this is all lost in handling that pipe, and the 2% that we have given to that is, I believe, far less than the loss you will actually find in practice and experience.

880 Taking all these factors into consideration, we next have to find out what this pipe is worth. I have allowed as the price of this pipe the maximum amount that we would pay today for this pipe if offered for sale at one of our stores where we are actively selling that size pipe. In connection with the large pipe, I want to say that from month to month, as fewer cable tool wells are drilled, the use for large casing is diminishing, and in some of our stores where we have 20-inch and 15½-inch casing in stock, we haven't sold 100 feet of either size of pipe in the last 18 months. So, while I am giving the top value which we would pay, I am frank to say that if we had to buy this pipe today, I don't think we would offer the price I have indicated for it because we wouldn't know what to do with it.

Those prices are as follows: the 20-inch, $3 per foot; the 15½-inch, $2 per foot; the 12½-inch, $1.50 per foot; the 10-inch, $1.10 per foot; the 8¼-inch, $.77 per foot; the 6⅝-inch, $.50 per foot.

I will also make the statement that within the last 90 days I believe we bought pipe of each category, small quantities of it, at less than the price I have placed on it in this salvage study.

When you deduct the 2% for pipe loss in shopping, the hauling of this pipe to the railroad, and the freight, and the $5 per ton for reconditioning that I have outlined, from the value of Texoma's one-half of this pipe at a common point in Texas, which value is $13,529, and since it covers fifteen wells, the net salvage per well for Texoma is $603. Now that is the average price on these fifteen wells. I think it is a very fair average of all of the cable tool wells of the Texoma in the Panhandle.

There is a progressively declining demand for used oil field casing. Fifteen years ago the majority of wells drilled in the oil country were drilled by the cable tool method, and in drilling wells by that method they would use three or four strings of large casing to shut off upper stratas of water as the well was being drilled. These strings were not particularly long. It was not particularly dangerous to run used pipe in these strings because they hadn't yet reached the oil or gas bearing formations. Usually companies that drilled wells used and reused various strings of surface pipe, and would buy new strings of pipe for the final string which they left in the hole as they pulled the others out. Sometimes they couldn't pull the others out and from time to time would have to replace their surface strings of pipe, so there was a demand for considerable pipe in every well that was drilled.

Under the rotary method you set a small amount of surface pipe to shut off the surface quicksand or water, or whatever is at the surface of the hole you are drilling; then you wind up with one string of pipe at the bottom of the well, protecting the oil or gas which you had discovered below this string of pipe.

The average cost of drilling a well in the Panhandle is $20,000. On the Gulf Coast of Texas it may range from $45,000 to $50,000. In some cases wells down there cost $150,000 or $200,000 to drill and complete, wells that range in depth from 8,000 to 12,000 feet. You can't conceive of an operator risking the investment in that hole by trying to

get a small saving by using for his one string of pipe
881 which is in that well used material. So you just have to find your customer for used casing among small outfits that aren't financially very strong and have to make every saving they can and who are willing to take the chance in completing a well in setting a string of used pipe in it.

Another thing, as drilling goes on in the Mid-Continent field, wells get progressively deeper. Twenty years ago the average well was drilled, I suppose, to a depth of 2500 feet; fifteen years ago to 3000 feet; today the average well is probably 1,000 or 1,200 feet below that. As deeper wells are drilled, you require better materials. You require materials with greater factors of safety, that will stand more tension and are just better made all the way around, and naturally when you pull out the material from old wells, you are just going to have a hard time to find a proper place to put it in current operations. Even today, if all this 8-inch pipe were pulled from the Panhandle, it would be a very difficult matter to go over all the oil country to every field that is being drilled and find a place where you could dump that pipe to be resold as casing. I don't think you could do it.

Leaving the wells and starting out towards the Fritch station we immediately run into what we call the gathering lines, or the lines which transmit this gas from the well head to the main gathering line, which in turn takes it to the initial compressor station. I have had experience in handling that type of equipment, gathering line pipe of the dimensions of that used by Texoma. We are constantly selling gasoline plants, which are being built all over the country, light weight pipe which they use for gathering lines, vacuum lines, residue lines, and so forth—pipe of the size and similar weight to that employed by the Texoma Company. A little different situation obtains with reference to this type of equipment than that of the gas well equipment. There is a limited market for used valves, for used fittings, and for used pipe. Before any responsible organization, however, will sell that kind of equipment to the trade, they naturally want to put it in first class condition.

I helped prepare this salvage estimate on those lines, and I placed a value of $20 per ton upon all of the pipe, 12-inch and under, and all the valves and fittings in the gas pipeline of the Texoma system. That means that we would

take up approximately 11,000 tons of scattered pipelines running in size from 4 inches to 12 inches, that we would pick up out of the compressor stations and out of the lines some 6800 tons of assorted fittings of every kind, nature, and description.

Now that is a great quantity of fittings. I don't believe that all of the used material dealers in Oklahoma and Texas together will sell that many used fittings in a 2 or 3 or possibly a 5-year period. They might, because some dealer might get a large plant and find an occasional market for it, but these fittings will have to be sent to a machine shop and checked over. The valves especially should be reground and refaced and retested to such pressure as the supply companies selling them would be willing to guarantee to the buyer. The lines would have to be taken up, probably cleaned of the enamel that coats them, rebeveled for welding, and probably in some cases checked as to
882 test pressures they will stand, pretty closely. We have allowed a figure in these compilations of $15 per ton for doing this work. I believe that figure is very reasonable.

Let's take a concrete case to show what I mean. The 4-inch pipe weighs 7.63 pounds, approximately 8 pounds, per foot. If you take that pipe up out of the line and haul it to the railroad for an average distance of 7 miles, we estimate it will cost $15 per ton to do that job. Let's assume that $3 is the charge of hauling it to the railroad; which is a very reasonable charge for that length of haul. That leaves $12. With that $12 we have to ditch the line; that is, dig a ditch, and it is buried to an average depth, according to company records of 34 inches. We have to take the pipe out of the line, cut it into rough sections about 40 feet in length, and reditch the line. The pipe weighs about 8 pounds, slightly less, per foot, so we are getting less than 5 cents per foot for that operation, and it would be a hard thing to find a contractor to really perform that operation, or to do it yourself, for that 5 cents.

Similarly, you can take all sizes through the system. Therefore, I believe this $15 estimate, if anything, is on the low side.

The price we have estimated for this pipe at the depot is $20 per ton. New line pipe of this character sells at the mills today, and I am buying it for my company almost every week, at least some quantities of it, from the National Tube Company, or the Republic Steel Company,

or some other manufacturer, at prices ranging from $45 to $50 per ton, and when you buy it in large quantities, as Texoma did when this was ordered, you buy it at prices approximately 10% less than the regular price. Therefore you can see that by the time this $20 a ton pipe is shipped to a point where it will be reconditioned, beveled, cleaned up, and offered for sale, that competing with new pipe it is going to be hard for the supplier who has ventured to buy the pipe and taken the risk of investing his money in it to make any money out of the venture. But I will say there is a possibility of a small salvage value in the pipe and in the fittings, and that is why we have given them these prices on these estimates.

I have seen some of Texoma's properties. I have been through the gasoline plant and the Fritch compressor station. I visited dozens of the wells in the field at different times, and last week while I was in the Panhandle I particularly went back to two or three of these wells to check up on the equipment around them and to be sure that I knew what I was talking about when I discussed them. I have been to the Gray station. I guess that is the Natural Gas Pipeline's station. I have been to the Joliet meter and regulator station. I have driven down to Geneseo on the main line in Illinois. I have driven to the Fox River crossing, I believe it was called, and have driven to the Mississippi River at the crossing of the pipeline near Muscatine, Iowa, and have examined the river crossing in the Panhandle on the Canadian River. I did not examine that last crossing particularly, but I have seen it a number of times when I have been in the Panhandle.

I took note of what they refer to in their property records as the steel frame buildings that are located at Fritch and these other compressor stations. I looked at those buildings carefully at the different places where I visited. Assuming the same type of buildings will be found at those other stations which I have not visited, I find that there is some salvage value to these steel frame buildings. Elim-
883 inating the foundations entirely, which have no salvage value, you have the structural steel framework, the galvanized iron sides, the roofing, and the windows and doors of these buildings. These main compressor buildings are very large buildings. They are 68 feet wide, and the one at Fritch is, I believe, 244 or 245 feet long. The others range from 168 feet to a length 28 feet greater than that. Some of them were extended, as I understand it, in length.

These buildings are pretty high. I cannot conceive or find any ordinary use for these buildings somewhere else of the size they are now built. The buildings are too large. No lot would be just large enough to fit them. No industry would be just the right size to utilize them. The principal value of those buildings is the steel that is in them, the doors and windows that are in them, and stuff of that kind, and those buildings could be bought by a dealer who deals in buildings and refabricating them, using most of the material in smaller sized buildings.

Now as to these smaller buildings, two of them are too large for use generally, but most of them are what we call ordinary oil size buildings, the kind of building that can be used in building a new gasoline plant and for a dozen other purposes in the oil fields. Of course, they would have to be dismantled. If the buildings I looked at were fabricated any place, I believe they could be dismantled with somewhat more ease and facility, but the others would be more difficult. However, they all could be dismantled and shipped away to some other location where they could be utilized. That is why I gave 10% valuation to the smaller buildings and 5% to the larger buildings, and we based that valuation on the original cost of those buildings without taking into consideration the cost of the foundations. That represents my estimate, in round numbers, of what these pipelines will be able to salvage for those buildings.

I do not believe those roofs can be satisfactorily salvaged. I would just forget them. They are just waste like the foundation.

Occasionally you can find dealers in the larger cities who are engaged in the business of acquiring buildings of that kind. I do not know of a single dealer who is exclusively in that business in the Southwest, but a number of dealers down there will buy buildings if they can buy them cheap enough to make a dollar. Most used material dealers will venture into anything they feel they have a chance to make a profit out of if they know enough about it. There is a demand in the oil fields and perhaps in other places for that type of steel frame buildings. I believe that any one building a gasoline plant, or at least a large number of builders of gasoline plants, and others, maybe builders of small refineries or gathering station buildings, the small type of buildings, I believe would be a market for these used buildings of smaller sizes. This is the type of building

that is ordinarily used in the oil fields for various oil operations. If the size does not fit one customer, it will probably fit the next one.

The reason for the difference in the attitude of the oil companies toward this kind of equipment and that toward casing that goes into the well and the pipe that goes into its pipeline, and things of that kind, is that when you drill a well the pipe or string of casing is going into the well and protect your investment. If, for instance, the string of pipe is lost, that probably is the end of the well. It is a very expensive matter to repair such an error. For
884 example, since I have come here to Washington I have learned that we were drilling a well ourselves, in which I had an interest, in the Camp Munger Allen oil field in Texas, and we lost a string of 26-pound casing in that well. The drilling contractor that was completing that well dropped his tools in the hole and broke the string of pipe in two in the hole. Just the pressure of the tools going down through the hole burst the pipe, and he had to set inside of that a string of 5-inch casing, a special size, which we had to order from Houston and rush it up to the well, and I believe it is now being cemented in the well. In other words, dropping the tools just accidentally caused $4,000 or $5,000 worth of damage in that one spot.

So you see a person has to be careful of what kind of material he uses in these wells. But a building is something that can be seen. It is on the top of the ground. If a truss, or anything else on it, goes wrong, it can be replaced by another. In the pipeline, where you put gas in the line under tremendous pressure, a break is a very serious matter. It costs a lot of money. It would cost more to repair than all the saving you could make by the possible use of a used valve or used fitting. You cannot take the same risk in dealing with casing, engines, or equipment such as we have been discussing here, as you can in the case of a steel frame building.

I have been through some of those cottages, duplex cottages, bunk houses, boarding houses, and office buildings. Those cottages have been figured in Exhibit 122 at $100 per cottage. When I first came to Chicago and went over the whole inventory with Mr. Davidson, I told him a house like that could always be sold to somebody or other, and I thought a valuation of $100 would be fair, because in fooling around with different properties and handling a lot of houses like that we usually get that much out of

them. After going back to Fritch and looking the thing over I realized that when these projects are abandoned there will be a great migration away from the Panhandle. The dust storms up there have been very severe. It is in what they call the dust bowl of the Panhandle and Oklahoma, and people are not living there unless they have to, unless they are working for companies engaged in business there, except a few ranchers. The population of Hutchinson County, where Fritch is, I believe was 13 before oil was discovered, and I have been told that there was not a lawyer or a doctor in the whole county—just a couple of ranch houses. Certainly when these oil fields are abandoned, while the Panhandle will not revert to such a condition, I suppose it will be a pretty barren place, and just at the present time where these houses sit, who will want to buy them? I do not believe they are going to have much value, but I did suggest that value, and Mr. Davidson set it up in the record.

When I visited the Geneseo station I noticed several of the towns were pretty empty. There were houses boarded up on the street, even large brick buildings boarded up, not being used. If that is an indication of the quality of the activity around there, I do not believe the houses will bring very much. Some of these cottages will probably be wanted by the farmers and by people who will want to move them to little towns. They are too large to move over the road very far, probably too large to pass over a bridge or something of that kind, but some of them will have some salvage value. From the portion of the set-up I have been, this value of $100 per house is high, but
885 probably is somewhere in line, taking the other stations which I have not seen into account.

I heard Mr. Taubman testify about this main line and this main gathering pipe, which is 24-inch dimension pipe, and these 18-inch, 16-inch, 12-inch, and 10-inch river lines, 6-run, 2-run, 3-run, and 5-run headers, and 24-inch and other dimensions of flanged gate valves which are used on this large diameter pipe and which are down below the ground with that pipe. We have bought a good many pipelines. We have bought them in a good many places, such as Wyoming, Colorado, and all the states of the Mid-Continent, but we never bought a 24-inch pipeline. None have been offered, and if there had been one offered, I do not believe we would have bought it. Oftentimes in effect-

ing a salvage deal you just cannot afford to buy it because there is no value there.

The function of the dealer in used material is to find materials which can be reconditioned and used in the economic system and be sold advantageously. This 24-inch line is absolutely worthless. There would be no market for it if it was salvaged, and if it had to be junked, the cost of shipping it to the junk market would greatly exceed any possible revenue that could be had for it. I heard Mr. Taubman's statement that in his judgment it would take $15 a ton to remove it from the ditch and to go through all the steps which I heard him discuss and get it to the railroad. I am in accord with his estimate except that I seriously doubt that it could be done for that sum of money. That is the minimum.

In a break-down of figures on which his estimate was based and which he went over there was, for example, a charge for ditching that line of 10 cents per foot. That line is buried to an average depth, I believe, of 59 inches to where the top of the line is, and it would have to be uncovered one-third below that. I do not believe you could go up and down the line and ditch it for 10 cents a foot. I suggest that figure as low. The river crossings and headers used in connection with them could not possibly be salvaged. The cost of salvaging would be more than it is worth. In most cases you could not salvage it even if you wanted to. You do not know where the lines have shifted in the beds of the streams. It would be like looking for a needle in a haystack to find those lines across these river beds. It just could not be done, and there is no question in my mind about that.

As to the water well equipment, such as motors and pumps, set out on Page 22 and some other pages of this exhibit, we have handled a good many motors in our experience in our purchase of other second-hand material. With reference to these Layne Western pumps, we have never bought or sold any of those pumps. I only know from my observation that it is very good equipment, equipment of that nature.

There is a salvage value of 10% of the original cost of those motors set up in the exhibit, and the salvage value on the following page of 10% on the original cost of motors acquired after June 1, 1939, is set up. I believe that is a proper value and reasonable and in line with the used

material market. Certainly that is the most that we could offer for that class of material if it were offered to us.

With reference to the pumps, I guess I was the one who suggested to Mr. Davidson this 10% valuation. I
886 probably did not think enough about the use of those pumps and the conditions under which they were used when I suggested it. There is a possibility that some of them could be sold, but when Mr. Smith and I went out to the Panhandle and I talked to him he told me very emphatically that those pumps had no value and that we should not have suggested any value for them. I think I would have to acknowledge that it was an error on my part in placing a value on them. I am convinced that they are junk. It would not pay to take them out of the wells and put them on top of the ground and junk them. They should be left where they are in the wells.

Listed in this Exhibit 122 is a large variety of property listed under the caption of "Tools." The lists appear on pages 43 to 47 and pages 87, 88, and 89. As to this type of equipment, every time you buy used material the object of the seller is to get you to take as much miscellaneous material of this kind off the hands of the seller as possible. We have had to take quite a lot of similar material, although probably not identical. The salvage value as set up in this report is 10% of the original cost. Frankly, all of this material could not be sold by any dealer anywhere. There are some items that a dealer would keep forever and not find any way to dispose of or anybody that wanted them. A lot of it is special equipment ordered particularly for this system. Some of the items you would get a little more for because they are more commonly used than others. I still think 10% of the original cost of this material is a large and fair valuation to place upon it for salvage.

There is another miscellaneous grouping of equipment under the title "Miscellaneous Equipment—Account 1006-J," appearing on pages 32, 33, 67, 68, 78, and 79. I am familiar with most of that equipment. Naturally, in any list of that kind there are going to be some special items that nobody is familiar with who did not order them. However, I believe what I said about the tools is also true of this material in its entirety, except this: If you can conceive of a second-hand dealer having all this material in his stock, you cannot conceive of the buyer of most of this type of equipment going to any second-hand dealer to

get this stuff, those specialized tools. If the dealer was in Houston, the use for them might be somewhere else in the country. It is small stuff. It would be hard to transport it, and even though there is 10% valuation placed on it, as to a great deal of it whoever gets it will never be able to dispose of it.

There are a number of different types of tanks appearing on page 27 and all through here. To save time I will classify them into tanks of what we call 450 gallons and down, or small tanks, and those 150,000 and 200,000 gallon elevated tanks built on the Fritch station and other stations. Tanks that are 15 or 20 years old will be in pretty bad shape. I do not believe there is much resale or salvage value to them. Just the other day I bought for our company three wells in Talco, Texas, and in connection with those wells we salvaged some tanks, two 500 barrel tanks, a 1,000 barrel tank, and one smaller tank. Now those tanks were only in use at Talco for about a year and a half, and yet when we examined them the bottoms were rotted out, and we sold them in place to a dealer in used tanks for about 5 or 6 per cent of what they originally cost. We were glad to get rid of them. Now we are dealing in tanks 15 or 20 years old, so I think the 5 per cent valuation set up here is very reasonable. I want to call attention to the
887 fact that a good deal of the cost of a tank is the cost of putting it up on the location where it is. The steel or material is not the only substantial item in the value of the average tank. A good deal of the value of it is building it, erecting it, and so forth.

These large 100,000 and 200,000-gallon tanks are elevated tanks, and they just have to be cut up. After they are cut up it will be a very difficult matter to rebuild them again. I do not believe it would be worth while contemplating that. I would sell those for scrap. Even a large tank, such as a 55,000-barrel tank, has a great deal of steel in it, and it only has a salvage value in the oil industry of five or six hundred dollars, and there have been hundreds of them sold over the past ten years at prices within that range. The small tanks are riveted also, but they can be hauled on trucks and carried away. They would not have to be cut up and re-riveted.

As to the laboratory equipment appearing in Account 1014 on pages 40 and 90, I noticed that there has been a salvage value of 20% given to that. This laboratory equipment includes a number of special items, and good

items, that have been purchased for the system. I believe they will keep this laboratory up in full notch order to the last minute, so they should have a higher salvage value than other classifications. Our organization in the last two years has equipped two or three refinery laboratories complete. In equipping such a laboratory we will issue purchase orders to 25 or 30 different manufacturers of laboratory equipment, and assemble this equipment, and sell it, and I believe you could sell this equipment, or most of it, although again some items might be hard to dispose of or perhaps might never be disposed of.

I believe the 20% figure is reasonable and proper as to the engines listed in Account No. 1024 on pages 92 and 93. There is one of them installed now, and Mr. Smith and I when at Fritch drove out there and looked at that engine. It is a combination engine and compressor cylinder used to increase the pressure from the gas wells to assist in boosting the gas into the line. I believe they contemplate, as the well pressures go down, installing these at different wells for the same purpose.

All through the country a 40 horsepower vertical gas engine is used for pumping oil wells, in connection with the power plants which pump oil wells, and are generally that size, so I believe those engines, if they are salvaged, could possibly be used throughout the oil country. We will always buy 40 horsepower engines. Usually these engines are three to five years old. Sometimes they are ten years old. They are seldom older than that. We pay prices ranging from $200 to $250 or $300 for these engines, depending on the condition of them, the manufacturer, the location of them, and how much it will cost to fix them up to resell them. So I believe the price of $200, or 10%, which we have placed on these engines, which is a little over $200, is a reasonable price and is in line with the salvage value of this type of equipment. Inasmuch as this is a new thing, none of these engines have ever been salvaged before. I believe this is the first one that was ever made.

Referring to the warehouse stocks, such as are listed on page 94 through page 102, consisting of engine parts, pipes, and fittings, casing, couplings, gate valves, and similar material, this is the type of equipment that I ordinarily deal in. That is, a good deal of it is. In contemplating
888 the salvage of this system we included in our calculations of pipe less than 12 inches in size the valves and fittings of this pipe and such valves and fittings as were

in these warehouse stocks. The only different factor is the cost of reclaiming. There will be no cost of reclaiming when it is in the warehouse stocks. It just has to be loaded with the other material into cars. That is true with reference to the Worthington engine parts. Since there is no market for these engines and they will have to be junked, naturally those parts for such engines would similarly have no value and should be sent up to the scrap heap.

As to the material other than engine parts, we have given the same value to that material that we have given to the reclaimed equipment of the same character, which is $20 a ton. All the material in the warehouse stock is not new and will not be new. They take new material out and bring material in from other uses when they are through with it, and a lot of that material in the warehouse stocks is second-hand material or material they had taken and cleaned up and put in the warehouse with a view of using it again if the occasion requires.

I have had experience in dealing with the type of equipment referred to in Exhibit 122 as cleaning tools. Our concern at one time made, and still has the facilities to manufacture, a complete line of cable tools, which these are. If we had a sufficient market we would manufacture these tools today. We still make certain cable tool specialties, such as Crotto wire line clamps, the Hardenberg underreamers, and other tools. The market for tools of this kind has been gradually disappearing over the last ten years. I guess in our own stocks we have between $200,000 and $300,000 worth of new tools that we would be happy to dispose of at 10% of their original sales price, or possibly less. However, in certain parts of the oil country, such as the Panhandle, there is still a small demand and a small use for cleaning out tools, and they are bought and sold.

After the wells are drilled, usually with the rotary method, if you want to go back in them, you employ a drilling contractor with a drilling machine or a spudder to go in there and clean out the wells, because it is too expensive to go into these holes with heavy rotary equipment. In the Wichita Falls area after we drill the holes out with rotaries, we drill them with spudders, so there is a small value to these tools. Remember this, however, that it is expensive to mishandle and to have trouble with tools. Tools that are 15 or 20 years old would be a very serious

matter to use, and a prudent contractor would hesitate very much to consider putting them into a well. Of course, there are certain minor improvements in the building and construction of this equipment. I think the 10% valuation which I myself placed on these tools is pretty liberal.

I have had experience in trying to dispose of material of this kind which has been accumulated on a rather large scale. At Pampa alone we have had months where we sold as much as $250,000 to $300,000 worth of used equipment. We have made sizeable used material deals. Several years ago we bought all the lapweld casing and line pipe that the Midwest Refining Company had in Colorado, Utah, and Wyoming. While I was up in that country Mr. Wilson the vice president of the Texas Company, got hold of me and asked me to inspect all their drilling equipment,
889 which they wanted to sell, as they were going out of the drilling business themselves and turning their work over to contractors. Their superintendent, Mr. Leo Daley, and I made a trip through Colorado and Wyoming to every one of their properties, the Florence, Isle Dome, and other points, and I looked at a group of tools which had an inventory value of almost $800,000. After I figured the freight on these tools back to the Mid-Continent field I had to inform the Texas Company that in my judgment they had no value at all, and I could not use them. I could not recommend anything for them. It is my understanding that they finally sold them to a junk dealer in Casper, Wyoming.

I have had experience in cleaning up plant sites after the salvage of the material such as buildings, engine units, tanks, and other above-foundation property have been removed. Oftentimes we have had to clean up leases when we left them. After I joined the Western Supply Company I bought a number of refineries personally. You remember the Oklahoma Petroleum and Gasoline Company that had a plant at Dual. I junked that plant myself, and we bought gasoline plants and junked them, and we built gasoline plants. We have had a lot of experience generally with that kind of work. Frankly, I think the minimum cost estimates shown in Exhibit 122 of $3600 in the case of all these plant sites, with the exception of Fritch, in which the figure is shown at more than $10,000, are very reasonable for cleaning up and conditioning these sites. I caused the auditors over there to do a lot of work. I asked them how much concrete was put into the

foundations and pits in those nine compressor stations and at Fritch. In answer they gave me, without adding it all up, the figure of over 42,000 yards. That just gives you an idea of the immense amount of these foundations, these concrete pillars, these concrete wall pits, and everything of that kind.

Now those plants today are just as clean as a whistle. There is no place in the oil country where any property is any cleaner or better kept than those compressor stations. There is no pin loose in it. There are no loose amounts of dirt or anything of that kind. I believe honestly that if I were offered the opportunity to clean those sites up for what Mr. Davidson has estimated it would cost, I certainly would not undertake to do it. I think the figure is very low.

You can't go off and leave those sites instead of cleaning them up and by that means save $3600. It would be a very dangerous thing for an individual or a corporation or anybody else to abandon a property that has deep pits in it which would be filled with water where people and cattle would drown, with walls sticking up all over among the weeds where people would drive down the country lanes and run into them. There is danger of that and other things that could happen, and anybody who is acquainted with the oil country knows these things could happen when you give the least opportunity for them to occur.

The prevailing custom throughout the oil and gas country is to clean up and level off these plant sites. If we buy a plant from any company, they will put in their contract an obligation for us to clean that off satisfactorily to the customer. You remember I mentioned a few moments ago we bought a few wells a couple of weeks ago at Talco, Texas. These three wells had three derricks sitting over them. Each derrick stands on four concrete posts about 4½ feet high. The city of Talco made us level those posts off, and we had to contract to have that done
890 before we abandoned those walls and pay the contractor so they knew the job would be done. Now anywhere in the oil country, whether you have to or not, you want to do that because you would not want to leave yourself wide open to all kinds of damage suits or lawsuits, even if you were not afraid of them and were protected by insurance. You would not want to leave a nuisance which would cause some innocent person to be injured or hurt in any way.

I spoke earlier about leaving the pumps in the bottom of the water wells. The wells themselves should be filled up and plugged, just like all the other wells in the system, for the same reasons that I have given with reference to pits. We cannot leave holes in the ground.

I have seen the list submitted to the Examiner this morning by Mr. Davidson of property which is not included in Exhibit 122 and which is not covered by his testimony in connection with that exhibit. He has described the property under the caption: "Non-salvageable property not listed in Exhibit 122." That covers such items as the telephone system, right-of-way easements, and various items that are set on those four pages. A great deal of it has to do with concrete work, concrete anchors, pipe racks, engine and building foundations.

When I first went to Chicago Mr. Davidson and I went over the entire property inventories of defendants. It was a tedious task, and it took several days to just go through it, and there are a number of items, principally these items here, that I would say have no possible salvage value of any kind whatsoever. He would jot them off, so I am probably responsible for a good many of these items being left out of the other exhibit. They are just worthless from any point of view whatsoever that I could figure out. Take the item of 28-inch highway and railroad crossing casing, which Mr. Davidson has testified would have to be taken out from under the railroad company's right-of-way easement. If all that pipe was at any one place, it could be loaded out, like this other pipe we have discussed, on a $20 per ton basis. That much could be salvaged out of the cost of getting it out of the ditches, but since it is scattered up and down the system, it would cost more than that to assemble it in carload lots at these various points, so it is just worthless.

As to the cooling towers, the Bentube sections have been salvaged, the pits under the towers are being filled up. What we are talking about now is a wooden structure. That is only good for kindling wood, if it has dried up enough to be used for that. It is just a series of wood slats that have had water running over them for years. We could not attempt to use them on new installation or anything of that kind. In my judgment there is no salvage value in any of the material listed on those pages.

Cross-Examination by Mr. Slaff.

I have never testified in any case on matters similar to those matters on which I am now testifying.

891 *Cross-Examination by Mr. Booth:*

My study of the salvage value, and the salvage values which I have attributed to material, are based upon such values as they exist in 1939. I have given no consideration at all or made any endeavor to arrive at any conclusions as to conditions which might prevail in 1954, except to that extent that in the used material business you are always handling material that is old. You get material offered to you that is 15 years old, 20 years old, 10 years old, or 25 years old. I mean you are always dealing with equipment of that age, and I believe it is reasonable to assume in dealing with equipment of that age that it is just about like it was 10 years ago, or just about like it will be 10 years from now. I make no effort to predict what the material will be worth 10 years from now. My conclusions are predicated upon conditions which prevail in 1939, and I have made no study or made no estimate of conditions which will prevail in 1954, fifteen years from now, except that in dealing with used material you are always dealing in material that is 15 years old, and it is reasonable to suppose that 15 years ago you were doing that, and if you were doing it then, it is reasonable to suppose that you will continue to do that and that similar conditions will prevail. There are, of course, exceptional conditions which can occur, but I do not attempt to be a prophet. I am not stating now that the conditions with respect to the sale of the properties of these two companies in 1954 will be identical with the conditions which exist in 1939. I am in no position to predict, nor do I endeavor to predict the conditions which will prevail in 1954. All I was asked by Mr. Morgan to do was to determine the salvage value of these properties and this equipment based upon conditions which exist in 1939.

Questions by the Examiner.

The corrugated iron tool house and garage at Kingsmill is not a structural steel building but just a small oil field tool house like a great many on that system. We have one of them of our own, I guess, two miles from there in the

Panhandle, that has absolutely no value whatever. This little water well house is just a tin-covered house over the water well. You would not haul it away for all the material in it.

Redirect Examination by Mr. Morgan.

They have those little tool houses with corrugated iron nailed to wood frame structures. We have them in that immediate vicinity not two miles from there. They are just built of two-by-fours with corrugated iron nailed on them to put tools into. They have no value at all when you build them and certainly are not worth anything when you salvage them.

892 HERMAN P. TAUBMAN, recalled for cross-examination, testified:

Cross-Examination by Mr. Booth.

(August 30, 1939.)

My estimate of the salvage value of the property of these two companies was based entirely upon conditions which prevail in 1939. I did not, and was not asked to, predict the conditions which will prevail in 1954. I would not call it unreasonable, if I were asked to predict the conditions which might prevail in 1954 effecting the salvage value of this property, because you have got always to figure back based on a certain age. I do not profess to know what will happen in the future. I do not know the business conditions which will prevail in 1954, which is obviously one of the factors and an important factor which would have to be considered in arriving at the salvage value of this property.

All I was asked to do was to determine the salvage value of certain equipment and property of these two companies on the assumption that the property was approximately 20 years old and based on the salvage market value conditions in 1939.

893 (August 31, 1939.)

(EXHIBIT 122 for identification was offered and received in evidence over the objection of counsel for complainant and counsel for the Commission, who were granted exceptions.)

894 F. C. HAMILTON, a witness for the defendants, testified as follows:

Direct Examination by Mr. Morgan.

(August 31, 1939.)

My name is F. C. Hamilton. I live in East Orange, New Jersey. My place of business is at Sixty Wall Tower, New York City. I am a consulting engineer engaged in making valuations of public utilities and natural gas pipelines for various purposes. At the present time I am consulting engineer for Electric Advisers, Incorporated. My time for that corporation is devoted to valuation work although that organization is not devoted to that type of work.

I have been engaged in valuation work since July, 1914. From July, 1914, to April, 1917, I was employed by Harold Almert in the Rookery Building in Chicago. During that period two of the principal valuations on which I worked were the Washington Railway and Electric Company in the District of Columbia and the Commonwealth Edison Company in Chicago.

From April 1, 1917, until October 1, 1935, I was employed as a consulting engineer by Henry L. Doherty and Company, who were employed by the Cities Service Company to supervise operations of the subsidiaries of the Cities Service Company.

From October 1, 1935, to December 31, 1937, I was employed by the Cities Service Company directly, and from January 1, 1938 to date by the Electric Advisers, Incorporated.

The valuations with which I have been connected were of natural gas pipelines, utility properties and oil properties for the purpose of purchase or sale, and valuations of natural gas pipeline and utility properties for the purpose of establishing rate bases before courts and public utility commissions and some city councils. There were valuations for the purpose of presentation before state commissions and later the Securities and Exchange Commission in connection with the issuance of securities. There were valuations for insurance purposes and for tax purposes. There were valuations for presentation to bond houses and insurance companies having to do with the sale of securities.

At all times during my employment above outlined I have been at liberty and have received employment from companies other than Cities Service and its subsidiary companies. Electric Advisers, Incorporated, is owned by the subsidiary companies of Cities Service and is a purely service at cost organization, so far as those companies are concerned.

Some of the companies for whom I have prepared valuations or rendered valuation services outside of my own organization are Columbus Gas and Fuel Company in Columbus, Ohio, The Iroquois Natural Gas Company at Buffalo, the Calgary Gas Company at Calgary, Canada, the Federal Gas and Fuel Company at Columbus, Ohio, the United Fuel Gas Company at Charleston, West Virginia, the Pennsylvania Gas Company at Erie, Pennsylvania, the Jamaica Water Company at New York, the receiver
895 for the Kansas Natural Gas Company under Judge Booth at the time that company was in receivership, and many others.

I have appeared before commissions, municipal councils, and courts in connection with these valuations in about 22 states, namely: Connecticut, New York, Pennsylvania, Maryland, North Carolina, Virginia, Texas, Georgia, Alabama, Mississippi, Arkansas, Tennessee, Oklahoma, Kansas, Missouri, Colorado, Wyoming, Washington, Minnesota, Illinois, Ohio, Michigan, District of Columbia, and the provinces of Alberta and Ontario, Canada. The amount involved in these various valuations was considerably in excess of two billion dollars in the aggregate.

During that period there were purchased through negotiations which I have conducted 37 properties on which I fixed valuations, totaling $165,000,000. During that same period I valued properties which were not purchased, because of failure to meet on prices, in the amount of $95,000,000. I have made valuations for the purpose of conducting negotiations for the sale of 23 utility properties with a total value of approximately $60,000,000. During the same period I conducted successful negotiations for the purchase of 29 oil properties with a total value of $53,000,000, and conducted negotiations in connection with other oil properties which were not purchased to the number of 34, with the total value of $106,000,000

Those were negotiations for purchase and sale. In those transactions I had the responsibility of arriving at the value for the interest I represented, and those I represented

relied on my judgment a great portion of the time as to whether or not they would purchase or sell the property so far as its valuation was concerned. They have relied upon my judgment a great portion of the time except that in the 1927 and 1928 boom I advocated the sale of some properties, and they disagreed with me.

A very large portion in total number of dollars falls under the classification for the establishment of rate bases of various properties, and another considerable portion under the classification of establishing a value for the issuance of securities and/or the sale of those securities.

I have had a considerable organization throughout the whole period, varying in number of men from 15 to a high of about 75. As I recall it, there are about 55 men in the organization now. Some of them have been with me for as much as 22 years, and the average of the nine top men is in excess of 15 years. The force is almost entirely made up of graduate engineers from the leading colleges, who have had experience in natural gas pipelines or on utility properties prior to coming with me. I consider that this organization and force which I utilized in these studies is composed of men competent to perform the duties to which they are assigned. I have been completely cold-blooded in weeding out people who were inaccurate, unwilling to devote their entire energy to the work, and who seemed to me to lack the mental ability.

I have been going back with valuations to the same commissions over and over again, many times for the same clients, and that is something that cannot be done with a force that is either careless or inaccurate in this work.

896 For use in the valuation of a property such as that of a natural gas pipeline I have prepared myself with factual data concerning what is involved in the construction of a property of that kind. For years it has been my practice on new pipeline construction jobs, whether they were being conducted by contractors or by the Cities Service Company or by the forces of other companies, to put men on those jobs to follow the construction from the beginning to the completion of the work. They have kept the time of the men and gangs by the units of work which those men or gangs were doing. By that I mean a gang for trenching, a gang for backfill, and so on. Those hours were so kept that they would, at the labor rates then prevailing, balance out with the payroll that was being kept on the job.

I wanted that for the purpose of establishing the man

hours that were necessary to do a specific piece of work, so that, with those man hours and with that gang set-up I could, at a later date, apply a changed labor schedule that might then be in force and arrive at what would be the cost of reconstructing that pipeline at a period when prices had changed. I incurred the expense of doing this work and I never was recompensed for that work at all, except in the sense that on later jobs I had available for my use accurate information, and my recompense came in the fact that it secured me employment because of the accuracy of the data. That was an expense and a means which I incurred and adopted as a preparation for the work that I am holding myself out to do.

As an incident to learning the number of man hours required to install a given unit there was kept the original cost of the equipment, the type of the equipment, and the gasoline and oil consumption where they used gasoline and oil, and the maintenance cost.

I made and kept a record of this character on the work on Natural Gas Pipeline Company of America and Texoma Natural Gas Company. At the time this line was constructed it was the largest line constructed as a single unit up to that time, and I wanted to and did get time studies on that line in great detail. I have used those time studies and the other information which I got in the same connection in the work concerning which I am about to testify.

In applying these man-hour costs, unit costs of that character, I have taken into account such changes as I have found in the character of the machinery employed or appliances employed—in other words, the technological changes that have occurred in connection with the construction of properties of this kind—because we are familiar with the changes that have been made in the equipment. I have made it my business to keep up with the changes that have been made. I am familiar with the relative man hours that are required and have given effect to those changes where they occur as the result of any technological improvements or advances.

I have been keeping this man-hour and similar type of study and records since about the year 1925. I have kept it up to the present time and am engaged in making out at the present minute on 40 miles of 8-inch line, being laid southwest from Hutchinson, Kansas, to a gas field there. I have kept up that practice of sending men out to these construction jobs and getting studies of this character and

have observed the records of them from 1925 to the present date.

897 I have been asked to make a valuation of the properties of the defendant. I was engaged to perform that service in February, 1938, and the work started about the first of March and continued to the 20th of August that year. In fixing the valuation I took a date certain as of January 1, 1938. There were employed on that work at that time 1894-1/2 man days.

That is not all the work we have done in that connection. Again in April, 1939, I was requested to bring that valuation down to date by the additions and betterments that had been made in the meantime, the removal of such small items as had been retired, and bringing the valuation up to a date certain as of June 1, 1939. On this work there were 725 man days employed.

I was asked to value all of the physical properties with the exception of leases. In other words, I took the wells and well equipment on the leases but did not attempt to establish a value for the leases themselves. I took all other physical property, pipelines, compressor stations, buildings, and so on, and did establish first the cost of reproduction of those physical units without including anything except the costs of the inert property at the time of completion before it had been seasoned and before it had business attached to it.

I had access to the books and records of the companies but did not attempt to establish the original cost of the property, but I did use those books and records as checks on the inventory as to quantities. We were not told by the management of these companies at the time we were asked to place values on these properties, with the exception of leases, as to the methods we would pursue in arriving at the values. Our task was to arrive at the value by such means as we, with the training and experience that we had, saw fit to use.

I started first with the cost of reproduction of the physical property, including those items of interest, taxes, and other necessary costs during construction that are sometimes called overhead, but which are just as necessary as the labor of the man who digs the ditch. I then, on completion of this, deducted from that cost of reproduction the observed depreciation which was prepared by P. McDonald Biddison. I took the figures for existing depreciation on the present properties and applied them to the cost of re-

production and by that means arrived at my conception of present value. That is the method of arriving at present value that I have always employed in connection with the valuation work which I have done throughout all these years.

In addition to ascertaining the cost of reproducing the inert physical properties, including the overhead charges of various kinds which I have mentioned, I, at the request of these companies, have also undertaken to develop the going concern value of the property as separate and distinct from physical property itself. In that connection I have worked out the necessary working capital that must be employed in a business of the character and magnitude of these pipelines. All of those are included in the studies which we are prepared to present to the Examiner.

898 When we were employed to undertake this study back in February, 1938, I assigned Mr. H. L. Eastman, Mr. J. L. Willard, and Mr. Frank Stoddar to supervise the gathering of the information and the putting together of this information under my direction. These men were all experienced and had been with me for many years. With that group went a large number of other men who worked under the direction of these three in the preparation of that valuation.

There were employed 21 men in the period from March to August, inclusive, in 1938, and 12 men in the period from May to August, inclusive, in 1939. These men have devoted a total of 2618 man days to this work.

To Mr. Eastman I assigned the establishing of the labor rates in the various sections as of a particular time and the establishing of the value of rights-of-way and of land, and the determination of the working capital and the overheads, such as interest, insurance, taxes during construction, etc.

To Mr. Willard was assigned the supervision of the inventory of the physical property other than the well equipment on the leases and other than the measuring stations. The inventory on those last items was assigned to Mr. Stoddart. There was assigned to Mr. Willard the build-up of the unit costs from the time studies and from the labor rates which would be supplied to him by Mr. Eastman. Other details they adjusted among themselves and assigned the necessary men to work out the details. The group that worked on this last job had an average of 11 years in my employ, and all of them had experience prior to coming with me.

As I have always done my work it goes into very great detail. I have prepared a detailed inventory of all of the existing physical properties of these pipelines with the exception of the gas leases. I have not only broken that down into units, but, for the purpose of pricing the units, have broken them up by districts many times because of the variation in freight rates, the variation in labor costs, and items of that kind.

There are so many different items, so many different sources of manufacture, so many delivery points, that a freight rate study is a very detailed proposition, and we have applied the present freight rates which, by the way, were changed from the rates in existence at the time of the 1938 valuation. I mean by that that in the interim freight rates have been raised 10%, as the papers refer to it. Of course, no individual rate was raised exactly 10%. The average raise was 10%, and we had to get the new specific freight rate that did apply in order to attach it to the particular item and to the particular delivery point to which this item had to be delivered.

The labor costs similarly had to be gone into in great detail because of a large variation. For instance, in the rates for common labor in the States of Texas and Oklahoma and the rate for the same common labor in the district around Chicago there is a large variation. In other words, there is a variation there of probably 80 or 90% that the rates in Chicago for the same item are above the rates in Texas.

899 We had to vary our prices by states, for instance, because of the difference in the taxes that apply to payrolls or the labor item, one state as against another, and because of the difference between, or the absence of, use and sales taxes for materials. Those are just samples of the detail to which it is necessary to go in order to get an accurate determination of what it would now cost to reproduce this property in its present location.

I have assembled the detail of these inventories and set out the cost of reproducing each unit of the physical property in the form of a volume or compilation to be offered as an exhibit in this case. I have kept up with the preparation of that exhibit and examined it and know what is in it. I have spent a lot of time on it myself.

(At this point the witness was handed two volumes numbered I and II respectively, each captioned "Valuation Natural Gas Pipeline Company of America, Texoma Natural

Gas Company, F. C. Hamilton, Consulting Engineer, New York, New York," and at the request of counsel for the defendants the Examiner directed that these volumes be marked for identification as Exhibit No. 125, Volume I and Volume II.)

These are the compilations which we have prepared as exhibits to be offered in this case.

Mr. Slaff: Then at this time I should like to object, Mr. Examiner, and to be heard on the objection to the introduction of any evidence dealing with the reproduction cost of the properties of the defendants-respondents on the ground that that evidence is irrelevant, immaterial, and incompetent in this proceeding, and on the ground that that evidence of reproduction cost has no bearing on the determination of the proper base for rate-making purposes in this case.

This is a proceeding under the Natural Gas Act, and I want to call the Examiner's attention specifically to Section 6 (a) of that Act which provides, in part, that "the Commission may investigate and ascertain the actual legitimate cost of the property of every natural gas company, the depreciation therein, and, when found necessary for rate-making purposes, other facts which bear on the determination of such cost or depreciation and the fair value of such property."

Now your Honor will observe that this is a legislative expression of a fundamental departure from previous rate-making concepts as they have existed in some quarters. In the first place, there is no statement in this section, or elsewhere in the act, that among the "other facts" to be investigated and ascertained which bear on the determination of "the fair value of such property" is the reproduction cost of such property. Now it is not an immutable constitutional concept that a determination of reproduction cost is a prerequisite to the determination of the fair value for rate-making purposes of utility property and the fixing of utility rates. I am fully aware, your Honor, of Smyth *vs.* Ames and the other decisions of the Supreme Court on utility matters, but it is quite clear to me, as the Supreme Court itself indicated in the term just past and in the preceding term in such cases as Graves *vs.* O'Keefe and Erie *vs.* Tompkins, that fundamental concepts of constitutional protection of property rights must be adjusted in the light of the economic experience of the nation.

Now I do not mean to imply at this time, or at any other

time, that constitutional rights are to be subject to rapidly shifting vagaries and year-by-year changes, but I do mean that the Supreme Court itself has declared that when the progress of our complex economy has rendered obsolete or unworkable doctrines which had until that time been more or less accepted it was not in violation of but rather in keeping with the spirit of constitutional government that such doctrines be replaced by those which fit the needs of the modern age.

Now Congress recognized this in the passage of the Natural Gas Act and pointedly omitted to charge the Federal Power Commission with the duty of investigating and ascertaining the "reproduction cost" or the "replacement cost" of the property of natural gas companies, while specifically authorizing it to ascertain the actual legitimate cost of such property. Nor can it be successfully argued that this commission is charged with the duty of ascertaining reproduction cost under the doctrine of Smyth *vs.* Ames—ergo there was no need for congressional mandate—ergo the congressional omission is meaningless. That such argument falls of its own weight is at once obvious from the fact that, under Smyth *vs.* Ames, ascertainment of "actual legitimate cost" of the property,—there referred to as "the original cost of construction",—is also an element in the determination of fair value. Hence if Congress had intended to follow that case implicitly there would have been no necessity, either, for the explicit direction by Congress to the Commission to ascertain actual legitimate cost. The explicit inclusion of the one and the explicit exclusion of the other shows clearly that Congress recognized the inherent invalidity of reproduction cost determination as an aid to the process of fair rate-making. It is clear, therefore, that Congress, cognizant of the fact that the experience of years had shown that determination of reproduction cost had been perverted from an aid to an impediment in the determination of the rate base, clearly ruled that factor out of consideration by this Commission.

The Federal Power Commission is instructed by Congress to ascertain the "actual legitimate cost of the property of every natural gas company and its depreciation". There is no blanket instruction, no blanket direction similar to this one to go into "other facts" bearing on the fair value of such property. It is only in certain limited cases, to-wit, "when found necessary for rate-making purposes"

that the Commission is instructed to determine "other facts" bearing on the determination of fair value.

Now there has been no showing whatever that in this case it is necessary for rate-making purposes that this Commission ascertain such other facts as the reproduction cost of the defendants'-Respondents' properties for rate-making purposes. Nor can there properly be such a showing.

I think, speaking generally, it can be ascertained confidently that the insistence by utility companies upon the introduction of evidence dealing with reproduction cost and that major weight be attached to reproduction cost as against any other element of value in the determination of the rate base has consistently impeded the regulatory processes in the past. This Commission itself has said, "It has been the considered judgment of the great majority of the regulatory commissions that the use of reproduction cost is not a proper factor in the determination of a valuation." And further, "The general opinion of regulatory authorities who have passed upon the question of the proper valuation base is overwhelmingly in favor of the prudent investment as opposed to the reproduction cost method."

The opinion of Commission counsel in this respect is expressed in the concurring opinion written by Mr. Justice Frankfurter for himself and Mr. Justice Black in the case of Driscoll *vs.* Edison in the term just passed that "the force of reason, confirmed by events, has gradually been rendering that formula (of Smyth *vs.* Ames) moribund by revealing it to be useless as a guide for adjudication. Experience has made it overwhelmingly clear that Smith *vs.* Ames and the uses to which it has been put represented an attempt to erect temporary facts into legal absolutes. The determination of utility rates—what may fairly be exacted from the public and what is adequate to increase enterprise—does not present questions of an essentially legal matter in the sense that legal education and lawyer's learning afford peculiar competence for their adjustment. These are matters for the application of whatever knowledge economics and finance may bring to the practicalities of business enterprise."

Congress, in the Natural Gas Act, has clearly indicated its intention to have the Federal Power Commission depart from that moribund formula of Smyth against Ames. In the light of that circumstance, there is no justification what-

ever for the introduction of reproduction cost evidence in this case.

Let me add, too, that Commission counsel is in wholehearted agreement with the fundamental principle of utility regulation which Mr. Justice Black very trenchantly expressed in his opinion in the McCart case, McCart against Indianapolis Water Company, 302 U. S., when he said:

"I do not believe that the constitutionality of action by a soverign state of this Union (or, I might add parenthetically, as in this case, 'the Union itself') is dependent upon the market fluctuations of cast iron pipe."

How particularly apt is that statement in the light of the very facts of this case where one of the major portions of the companies' investment is in just that very thing.

Moreover, Mr. Examiner, even if there were no such explicit expression of legislative intention as designated in the Natural Gas Act, and even if it were not for the fact that reproduction cost estimates have no sound place at all in the determination of a base for rate-making purposes, this case would fall squarely within the special type of situation covered in the Clark's Ferry Bridge Company case in 291 U. S., where Chief Justice Hughes wrote the opinion for a unanimous court. And in that case the court said:

"Appellant attacks the finding of fair value upon the ground that it was based solely on the original cost of the bridge property and that the amount paid by the appellant for the bridge was less than its fair value at that time and less than its fair value in 1930. It is not open to question that the reasonable cost of the bridge is good evidence of its value at the time of construction. And we have said 'such actual cost will continue fairly well to measure the amounts to be attributed to the physical elements of the property so long as there is no change in the level of applicable prices.'"

Now note particularly two things: first, that the Commission in the Clark's Ferry Bridge case took as the value of the utility the cost of its construction some seven years before the date at which the Commission fixed a fair value; and second, that the evidence introduced by the defendants-respondents in this very case establishes on its face that there is no change in the level of applicable prices, and that consequently the value of the properties in this case must be measured by, and only by, the actual legitimate cost of those properties, less depreciation.

Let me call your Honor's attention to Exhibit No. 67, which was introduced on behalf of the defendants-respondents by the Witness Palyi. Now, if your Honor will examine the indices on that exhibit you will note three that are particular pertinent to this discussion. First, is the companies' wage index. The Witness Palyi testified that this index was constructed by him as follows:

"From 1931 on we used the companies' own wage index, for which I had figures from the middle of 1931 until and into 1938. That index is a weighted, composite index of two indices, one for skilled labor used by the company and one for unskilled labor. Out of the two, by weighting in accordance with the annual expenditures in each category, skilled and unskilled, I constructed this one index number, which appears as the companies' wage index."

Now if your Honor will observe that exhibit and the witness' testimony, those wage expenditures were supposed to represent actual wages paid by the company to employees, and your Honor will observe that the company's wage index is at the latest date shown on Exhibit 67 lower than in 1931 at the completion of the construction of the company's property.

So, too, the second applicable index, the general price level index shown on that Exhibit 67, is lower at the beginning of 1939 than the average for the same general price level index during the period of construction of the properties of this company.

I call your Honor's attention to the fact that the Witness Palyi testified as follows:

"That is a very important aspect of the comparison; that the data for the history of the company covers only a short period. But I still say my impression of this price study is that there is a fair correspondence in the general trend in prices of commodities used by the company and in the general trend of what is called the general price levels in the country. This is, of course, theoretically obvious.

"If you spend money on these different types of commodities ranging from office supplies to storage batteries, from red lead to lumber, pipe, fittings, building materials, you cover so many things, as I mentioned yesterday, that, a priori, it would be most astonishing if your index number of prices fluctuated—would be very different in trend from the general index number, which would need an explanation if major differences for any length of time would

occur; but that the trend is about the same, as a matter of fact, ought to be a priori, more or less obvious."

I stated a moment ago that the general price level index on Exhibit 67 is shown to be lower at the beginning of 1939 than the average for that index for the period of construction of the defendants-respondents' properties. Carrying that price trend down to the latest available date—a fact of which your Honor can now take judicial notice when it is, as now, called to your attention in open hearing—carrying that price trend down to the latest available date, we find that it is even still lower than shown on Exhibit 67. Projected down to the beginning of June, 1939, the general price level index would show, on Exhibit No. 67, as a figure of approximately 118 for the month of May, 1939. This compares with the figure of 126 shown for the end of the year 1938, and with the average figure of approximately 136 for the period shown as the companies' period of construction in 1930 and 1931.

We now come to the third of the companies' indices which has significance in this discussion, to wit, the "Index of Prices for Commodities Used by Natural Gas Pipeline Company of America", which also appears on Exhibit 67.

Even had there been no explicit statement to that effect in the record, we would be justified in assuming that these commodities were representative of the trend of prices generally of all commodities used by the companies. Now that index, as of the latest date shown on Exhibit 67, namely approximately the middle of 1938, is just approximately where it was during the period of construction of the companies' properties and has begun a downward swing. And if we accept at its face value the statement of the companies' witness Palyi that "there is a fair correspondence in the general trend of prices of commodities used by the company and in the general trend of what is called the general price levels in the country", then, of necessity, the index of prices for commodities used by the company must be even lower today than is shown at the latest date on Exhibit 67.

Now, I take it, Mr. Examiner, that it is not this Commission's intention to penalize investors by the fact that prices at the time the Commission fixes rates may be lower than they were at the time of original construction; although as I have pointed out a moment ago, there has been a drop in the general price level of approximately 13 percent from the time of the construction of the companies' properties

to the present, I do not feel that the investors in this project should be penalized on this account. They are, as I view all the equities involved, and the constitutional requirements which are to be considered, here entitled to a fair return on the actual, legitimate cost, less depreciation, of the property now used and useful in the service of the public. Nor is it this Commission's intention, I take it, to penalize consumers when the converse of the facts which obtain in this case with respect to changes in price levels, is true.

And particularly, Mr. Examiner, when there has been little change in the applicable price levels and that change, if anything, has been to a point lower than the levels at the time of construction, I insist that the statement quoted from the Clark's Ferry Bridge case is applicable and that there is no necessity whatever that this Commission receive evidence of reproduction costs. For this hearing, and this Commission to engage in the incompetent mumbo jumbo, as it has been well called, of a reproduction cost estimate, would serve no purpose but to waste the time of everyone involved in this hearing and to delay the determination of the fairness of the rates of the defendants-respondents.

It seems to me, Mr. Examiner, that it is about time that this Gordian knot that has tied up the regulatory process for so long should finally be cut, and particularly is this true in the light of the fact that Congress has clearly expressed its intention that this be done in the regulation of natural gas companies.

Mr. Justice Stone aptly observed, in the concurring opinion in the St. Joseph Stockyards case, in 298 U. S., that, "the doctrine of stare decises, however appropriate and even necessary at times, has only a limited application in the field of constitutional law."

In the light of all these circumstances, Mr. Examiner, I must therefore object to the introduction in this proceeding of any evidence dealing with the matter of reproduction costs of the properties of the defendants-respondents, and I urge upon you that the rate base of the defendants-respondents be determined solely upon the basis of the actual legitimate cost of the properties, less depreciation, that is to say of those properties which are now used and useful in the service of the public, so that reasonable justice and speedy justice in the matter of rates may be done in

this case on behalf of investors, consumers, and the public at large.

Mr. Booth: If the Examiner please, I would like to add a word or two before Judge Morgan answers the excellent argument that was made by counsel for the Federal Power Commission. I join in the objection for the reasons advanced by Mr. Slaff. I believe that this is an unusual proceeding. It is not like an ordinary rate case because, as Mr. Slaff has pointed out, there is a special statutory provision which I want to read again because it is brief:

"The Commission may investigate and ascertain the actual legitimate cost of the property of every natural gas company, the depreciation therein and, when found necessary for rate-making purposes, other facts which bear on the determination of such cost or depreciation and the fair value of such property."

It is obvious that that provision applies specifically to this proceeding. It seems to me that there must be a determination or at least a showing before evidence as to reproduction cost is introduced, that it is necessary in this proceeding that consideration be given to reproduction cost, and no evidence of that character has been offered. There has been no evidence that in the determination of the fair value of this property, it is necessary that the Commission give consideration to or find the reproduction cost of the companies' properties.

And furthermore, under the facts in this case and the exhibit, copy of which has just been handed to us and has been marked, it seems to me quite clear that no consideration is necessary or can reasonably be given to reproduction cost and value of property.

I raised the point earlier that the testimony which this Witness Hamilton had been giving was apparently of a misleading character because he apparently had made a reproduction cost study of the companies' property and he was calling it, and counsel for the company was calling it, the value of the property of the company.

Now, in the first place that is clearly contrary to the provisions of Section 6 (a); it is contrary to all the decisions of the court that say that in the determination of the value of the property of utility companies, generally speaking, consideration shall be given to original cost and if necessary to reproduction cost, or to both, under the individual facts in this case.

However, if you look at this exhibit you will note that

on page 1 there is a reproduction cost new in the amount of $57,000,000, present value $54,000,000—the property is found to be at least in 95 percent condition. And that is the value of the companies' property.

Here is a property which, on the basis of the evidence submitted by the company has already operated for approximately 40 percent of its entire life, and yet, the company seeks to present evidence that in the determination of the rates to the consumers that the property shall be taken at 95 percent of its cost new, and that that is the sole element that shall be considered in the determination of the value of the property of the company.

Now it seems to be quite clear in my judgment that reproduction cost new under the facts in this case is not a necessary or a reasonable element because this is not an electric property, the company has presented evidence that the life of this property is going to expire in 12 more years, 10 more years. It must be clear that the reproduction cost new would be, upon the basis of the appraisal which the company is about to present, as high as the reproduction cost new which they have now submitted, if prices continue to maintain their present level between now and 1954, and their theory apparently is that even though the property would have only a few more years of operation, that reproduction cost new, less observed depreciation, be taken as the sole element in the determination of value of the property of the company, and that, it seems to me, is highly unjustified.

Mr. Slaff also referred to the general experience of regulatory commissions which have been commented upon by the Federal Power Commission with reference to the use of reproduction cost. I agree with his viewpoint that the experience of utility commissions generally is that reproduction cost is an impediment and a very serious impediment to the prompt and fair determination of utility rates.

He referred to a number of court decisions. I would like to add one or two. There is a very recent decision of the Supreme Court of Wisconsin in the long litigated Wisconsin telephone rate case, which was handed down only within the last 30 or 40 days by the Supreme Court of Wisconsin, where the Supreme Court of Wisconsin criticised very severely the Wisconsin Commission for determining the rates of the Wisconsin Telephone Company on the basis of reproduction cost.

The trend of judicial decisions, the trend of Commission decisions, is very clearly away from the giving of consideration to reproduction cost in determining the fair value of the property. It seems clear, therefore, that the motion of counsel for the Federal Power Commission, in which we join, should be granted, that there should be no evidence as to reproduction cost submitted in this case, and the Commission under the specific provisions of Section 6-A should determine the value of the property on the basis of the actual legitimate cost, less depreciation, unless it is definitely shown that it is necessary that consideration be given to reproduction cost.

Mr. Morgan: May we take our recess at this time?

Examiner Simpson: Yes, we will have a five-minute recess.

(Thereupon a short recess was taken.)

Examiner Simpson: The hearing will resume.

Mr. Morgan: Mr. Examiner, I have been, as we all have, devoting myself to the study of the facts of this case for the past several months, and I am not prepared to go into a discussion of the authorities in the organized and learned manner in which counsel for the Power Commission has done, and in using those adjectives, I don't want to be understood as utilizing sarcasm or derision, because I think it is a very apt and a very splendid discussion of the subject from the point of view of that school of thought which has been advocating for some years a change in the law, a change as yet not effected, however.

Section 6-A of Natural Gas Act, as already stated, does mention that "the Commission may investigate and ascertain"—they don't have to but they "may investigate and ascertain the actual legitimate cost of the property of every natural gas company, the depreciation therein and, when found necessary for rate-making purposes, other facts which bear on the determination of such cost or depreciation and the fair value of such property."

They are not necessarily talking about rate-making purposes in the first part of that section at all. Now they get down to talk about rate-making purposes "and for rate-making purposes other facts", showing clearly that the Congress recognized that under the law as it was then being declared and had been declared since Smyth against Ames, that it was necessary to ascertain other facts in order to arrive at the fair value of the property which term they

used here significantly, because that is what Smyth against Ames says, that it is the fair value of the property and not the original cost of it that must be given account in the matter of rate making.

Now there may have been Members of Congress who belonged to that school of thought which apparently Mr. Slaff and Mr. Booth subscribe to. By knowing something of the practical working of those things, I have some suspicion that somebody of that school of thought had something to do with the wording of Section 6. But the Congress, in enacting Section 6-A recognized that under certain circumstances it might be necessary to talk about other factors, and apparently one of the occasions when it might become necessary was when the Commission was investigating facts for rate-making purposes. There may have been Members of Congress who entertained the hope that the Supreme Court might, during the operation of this act, change the holding in Smyth against Ames and in the uniform line of majority opinions from that decision right on down to the present time, that it is necessary, in arriving at fair market value which the Supreme Court has uniformly held must be the rate base, to consider not only original cost but reproduction cost. They may have wanted to put the Federal Power Commission in a position so that if the Supreme Court held at any time during the operation of this act, that it was not necessary to consider anything but original cost, they might be in a position to do it. But unfortunately, from the standpoint of that school of thought, the Supreme Court has spoken again in the very case in which Justice Frankfurter wrote his dissenting opinion, and in that same dissent, Justice Frankfurter put this construction upon the majority opinion. He says that this court has reaffirmed the doctrine of Smyth against Ames, and that is the law, and I can't change it. This examiner can't change it. Mr. Slaff and Mr. Booth can't change it and nobody short of the Supreme Court of the United States can change it. I couldn't come here in the discharge of my responsibility to my clients and fail to present here evidence of reproduction costs which the courts have held, right down the line, must be considered in arriving at what the fair value of the property which the Congress itself calls the rate base in effect in Section No. 6-A is. And I can no more discharge my responsibility without bringing in here one of the necessary elements than I could if I didn't bring any evidence here at all.

Now Mr. Booth has taken pains to say that we are relying solely on reproduction costs. How does he know we are?

Mr. Booth: Your exhibit says valuation, and that is the reproduction cost appraisal.

Mr. Morgan: That is evidence of the value according to the testimony of the witnesses who are coming here to testify concerning these two volumes. But we haven't said we are relying solely upon it. As a matter of fact we are not. Yes—that is one of the things we are relying on. We say that the rate base is the fair value of the property, and we are bringing here evidence at this time of reproduction cost as evidence of the fair value of the property. Well, we will have other exhibits in which we will show the original cost and we are going to offer that ourselves as evidence of the present fair value of that property. This is just a part of our case, this is not all of it, and until we have rested, Mr. Booth is not at liberty, as I view it, to come here and say what we are relying on because we can't put all of this case in and state all of our positions at any one time.

Our position simply is this, that the rate base according to the doctrine of Smyth against Ames, which is still the law of the land, dealing with the constitutional rights of people, is the fair value of the property, and that the doctrine of the Supreme Court as announced in that case, and by the majority of the Court every time the matter has come up, is that in arriving at the fair value of the property, original cost must be considered and reproduction cost, less existing depreciation, must be considered.

We are trying to meet our responsibility under the law as it exists today because we can't change it, and we think that this would certainly be a record that would have to come back to the Commission if it went out of here without this evidence in it, and we are here prepared to present it and insist on the right to present it.

900 H. L. EASTMAN, a witness for the defendants, testified:

(August 31, 1939)

Direct Examination by Mr. Morgan.

My name is H. L. Eastman. I live in Maplewood, New Jersey. My place of business is at Sixty Wall Tower, New York City. I am associated with F. C. Hamilton, who preceded me on the witness stand. I have been employed by or associated with him, with the exception of a period of three years, since January, 1919.

I was graduated from the College of Engineering of the University of Colorado in 1917 with a degree of Bachelor of Science in electrical engineering. Immediately following my graduation I was employed by the Great Western Sugar Company, Scottsbluff, Nebraska, as a construction and later as an operating engineer. My employment with this company was terminated by the war when I entered the army.

While awaiting call to the army I took graduate work at the College of Engineering, University of Colorado, and completed the scholastic requirements for a Bachelor of Science degree in mechanical engineering. I spent the larger part of 1918 in the army.

Following my discharge from the army I was employed by F. C. Hamilton of New York City, who was then consulting engineer for Henry L. Doherty and Company. This was in January, 1919. In general I was engaged in the type of work already outlined by Mr. Hamilton in his testimony.

Upon my first employment with him I was assigned as a valuation engineer on valuations that were then under way. The largest property on the valuation of which I was employed during that two-year period, 1919 and 1920, was the property of the Toledo Edison Company in Toledo, Ohio. I was also employed on the valuation of the Durham Public Service Company of Durham, North Carolina and on a valuation which was being made for the receiver of the Kansas Natural Gas Company, involving property of that company and the Marnet Mining Company, a large natural gas system in Kansas, Oklahoma, and Missouri. I was also employed on valuations of the Wichita Natural Gas Company, the Quapaw Gas Company, the Webb City-

Carterville Gas Company, Carthage Gas Company, City Light and Traction Company, St. Joseph Railway Light, Heat, and Power Company, and some other smaller natural gas properties.

On January 1, 1921, I was employed by a group of natural gas properties which now comprise the Cities Service Gas Company of Bartlesville, Oklahoma, and I was employed by that group of properties as a valuation and rate engineer and on other general engineering problems. I remained with that group of companies until May, 1924, when I was again employed by Mr. Hamilton.

During that period of over three years I personally made detailed valuations of all of the natural gas properties operated from the Bartlesville office. I made studies of
901 rates for natural gas and assisted in various rate cases, of which there were quite a number during this period, wherein the rates charged by these companies for natural gas were increased and the companies put on a profitable basis.

From May, 1924, to June, 1925, while in the employ of Mr. Hamilton, I resided in Kansas City, Missouri, and spent that year on general valuation and rate matters of natural gas properties and electric properties in that general vicinity.

In June, 1925, I moved to New Jersey, and since that date have been continuously associated with Mr. Hamilton. Until October 1 of 1935 we were consulting engineers for Henry L. Doherty and Company, fiscal agents for Cities Service Company. From October 1, 1935, until December 31, 1937, we were employed as consulting engineers for the Cities Service Company, and since January 1, 1938, have been associated with the Electric Advisers, Incorporated, a mutual service company. By mutual service company I refer to the type of mutual service company defined in the Public Utility Holding Company Act. I believe we are registered under Section 13 of that act.

Since 1925 I have been in active charge, through Mr. Hamilton, of an organization comprised of probably a minimum of 15 to a maximum of 75 men, who have been for the most part engaged in making valuations and rate analyses for public utility, natural gas, and in some cases petroleum properties. I have been associated with Mr. Hamilton in all of the valuation work done during the period on properties of which the total value will aggregate two billion dollars. Most of these properties were

subsidiary companies of the Cities Service Company, and a large proportion were valued because of pending rate cases, for the purpose of security issues, or new financing.

We have also made numerous valuations of public utility, natural gas, and petroleum properties whose purchase was contemplated by the Cities Service Company or one of its subsidiaries. During this period from 1925 to date we have presented valuations before courts and commissions and other regulatory authorities in many different states, and I have personally appeared and testified before public utility commissions in the States of Oklahoma, Missouri, Texas, Kansas, Ohio, Michigan, Connecticut, and New York, and before the Interstate Commerce Commission and the Federal Power Commission. In addition I have participated in conferences over valuation and rate proceedings with public utility commissions in Colorado, Wyoming, Arkansas, Louisiana, Pennsylvania, New Mexico, Tennessee, North Carolina, and with the Securities and Exchange Commission.

Among the major properties which we have valued during this period from 1925 to date are the Toledo Edison Company, a major portion of the Ohio Public Service Company, the East Tennessee Light and Power Company, the Tennessee Eastern Electric Company, a large portion of the Public Service Company of Colorado, the Durham Public Service Company, the Empire District Electric Company, the St. Joseph Railway Light, Heat and Power Company, the City Light and Traction Company, the Knoxville Gas Company, the Spokane Gas and Fuel Company, the Republic Light, Heat and Power Company, the Dominion Natural Gas Company, Limited, the Southern Ontario Gas Company, the Cities Service Gas Company, the Kan-
902 sas City Gas Company, the Ozark Utilities Company, the Empire Pipeline Company, and many other properties whose purchase was contemplated and which we were requested to value.

In the Summer of 1930 I was sent to Western Canada to report on a contemplated natural gas pipeline project which had for its purpose the bringing of natural gas from the Turner Valley field in Alberta to the City of Winnepeg, Manitoba. In the Winter of 1930 and 1931 I was in charge of a survey of markets which contemplated the future marketing of natural gas, which it was hoped would be developed in large quantities in the Oriskany sand area of north central Pennsylvania and southwestern New York.

In the Fall of 1931 I made a complete detailed valuation of the Cities Service Gas Company for presentation to the Kansas Public Utilities Commission as a justification for the wholesale rates charged by this company. After presentation of this valuation and the other pertinent data this case was appealed to the United States District Court and eventually to the United States Supreme Court and was remanded back to the Commission for further findings. As a consequence we again made a detailed valuation of the Cities Service Gas Company in the Fall of 1934, and this was presented to the Kansas Commission during 1935. This case was later settled and disposed of by the Kansas Commission.

Since 1931 I have spent the greater portion of my time on the valuation of natural gas properties for presentation in rate cases before courts and commissions in the states of Kansas, Missouri, New York, Illinois, and in Washington, D. C.

I know about the record that Mr. Hamilton stated his organization had assembled and kept, and which he terms "time studies." I have quite a little to do with that study. We started this work as far back as 1925, and I have been quite familiar with each one of the studies that we have made since that time. The men actually engaged in the field in collecting and correlating the data were working directly under my supervision, and I familiar at all times with what they were doing. I have spent quite a good deal of time accompanying them in their work and endeavoring to see that the data which they collected was in the proper form and also to familiarize myself with construction methods.

We wanted this information for basic data and information which would be useful in making the valuation of similar property in the future. At the time the properties of defendants were being constructed we realized that here was the best opportunity that we had had up to that time to secure basic information of this sort on a large natural gas pipeline project, and we undertook to make time studies and collect data on representative sections of that line. We have had this data available and have used it in connection with the valuation studies that have been made by Mr. Hamilton and his organization, including myself, and which is now being presented to the Examiner.

I was among those first assigned by Mr. Hamilton to this particular study. After our arrival in Chicago, from which

point the greater portion of our work was conducted, and the assembling of our men to carry on this work, the first step was the preparation of an inventory of the property.

Fortunately for us in this work, these companies were
903 constructed originally in almost their present form.

That is, there have been very few additions to the property which we covered since the original construction. At the time of construction these companies kept a very adequate and detailed record of construction equipment and expenditures. They prepared a very excellent system of maps, and we made use of all this information which they had in their files in preparing the inventory of the property.

When it came to the pipelines, we made use of their detailed pipeline maps, which showed the chainage notes, the pipes, and details of all special installations. Their other office records contained detailed plans, drawings, specifications dealing with the material, and we assembled all this data which we needed from their files and carefully analyzed them.

Then we sent field parties out to take inventory to the property in the field and to check the quantities of material which we had obtained from their regular records against the quantities as actually existed. We sent men to the Panhandle gas field who made inventories of the top fittings of the wells, casing, and checked the records of those wells. We sent men to the various compressor stations where they checked the quantities which they determined from the records of the company against the actual material at those stations. We sent men to the various compressor stations and structures along the line, and they made inventory of the cottages, dwellings, and other buildings, and we obtained lists of the construction tools which the company had, and the laboratory equipment, and other small items of that nature.

This data was assembled then and brought back to the office in Chicago and summarized and reduced to workable form. Quotations were then secured and unit prices evolved which would reflect the conditions as they existed on June 1, 1939. This inventory of which I spoke was a complete field inventory, where such type of inventory was necessary. On other portions of the property, where we knew of our own knowledge that they had an accurate inventory from regularly maintained records, it was more of a spot check. We, of course, could not see all of the joints of pipe that were in that pipeline, but we could see the engines and the

buildings and those other things that are dealt with here as units. We actually inventoried the office equipment and furniture, mechanical equipment such as comptometers and adding machines, and all those things. We made a detailed list of all the physical property which went into these pipelines and which, when put together, constitute this pipeline system, with the exception of the gas leaseholds, which we did not include or value.

I was familiar with and supervised all of the work that was done. Personally I devoted a great deal of time to the appraisal of the real estate or land, the right-of-way, and to the calculation of certain costs which are detailed in the valuation and which we commonly refer to as general overhead. Also I made the calculations which were the basic data we used for working capital.

I did the field work which was necessary for the determination of the present schedule or levels of labor costs, and upon the completion of that work the various wage rates or wage levels which we have adopted and used
904 in this valuation were determined in conference with my associates.

For the most part the unit costs applied to the various units entering into the system were handled under Mr. Willard's direction. I kept up with it and kept advised as to how it was being done. I know what the results were from the exhibit which I helped prepare. I might state that in work of this kind it is absolutely impossible to delegate certain work to any one particular man. Most all of the work that is done is done by one or more men in collaboration. Calculations made by one man are checked by another, so that in a job of this kind probably three or four or five men are almost entirely familiar with everything that has gone into the finished report.

We determined what procedure would be necessary if this property were to be reproduced today, that is, the general method of construction. It was at once obvious that a pipeline system such as this would be constructed by general contractors. Companies of this character do not have a construction organization, and they never have a construction organization in the sense that they could construct and build themselves this entire property. So we undertook to determine from contractors who are engaged in building this particular kind of property the wage levels that prevailed as of June 1, 1939, and the wages they would have to pay were this property being con-

structed at that time. I personally visited the principal pipeline contractors and obtained from them the wage levels which they were paying at that time, which was June 1, 1939, in the territories traversed by this pipeline system, and of course these wage levels vary greatly throughout the territory covered by this system. They pay considerably more wages in some places up and down this pipeline than they do in other places. They pay more for hours of work. This pipeline traverses six states, and in the states of Texas, Oklahoma, Kansas, and Nebraska, and a portion of Iowa it could be constructed at the present time, I mean as of June 1, 1939, very largely with non-union labor. In the State of Illinois and in a considerable portion of the State of Iowa, however, union labor would have to be employed.

I do not mean that for all of the work, in most instances, non-union labor could be employed up to the central portion of Iowa and then union labor would have to be employed for all of the work east of that point, up to Joliet. The work of constructing the pipeline itself could be so done. The work of constructing the compressor stations, however, being of a different type and requiring a different type of skilled workman, is highly unionized, and all of the labor at compressor stations would be union labor, including that employed in the construction of housing facilities and other buildings. The work of constructing the pipeline across the State of Illinois would be solid union labor, as would also be true of a portion of Iowa. This applies even to the common labor employed in the handling of ditching and things of that sort. That coincides with the experience of contractors building lines in this area this summer.

In addition to the wage scales that I have obtained from the contractors—and I might say that the scales I obtained from the different contractors did not vary a great deal, they were very close together—we obtained union rates from union headquarters at various points along the line and at cities closest to the various compressor stations, and we have used those rates as wage levels in the calculations which we have made.

905 At the time this line was constructed we made the studies of the construction of major portions of the line, and at that time we obtained from the contractors the wages which they were paying and all of that information. That was for a specific job of constructing a

pipe line. As to what we have done now, however, we have seen a wide range of contractors and did not limit ourselves to the same contractors who constructed the pipe line in 1930 and 1931, although some of the contractors that we have interviewed this summer were the identical contractors which constructed portions of the system when it was originally constructed. There is not a wide range of contractors who do this particular kind of work. There are probably not to exceed 7 in the country equipped to do pipe line work of this kind. In investigating the present level of wages as June 1, 1939, I consulted with five contractors. Four of these five had done some of the work in connection with the construction of this particular pipeline system. There are only two other major contractors who are prepared to do this character of work. I did not consult with these other two because one of them is located in California and the other one in Texas, and I did not have time available to see them.

Among the contractors I consulted in this investigation were: Williams Brothers Construction Company of Tulsa, Oklahoma; Sheehan Brothers Construction Company of Tulsa; Kelly-Dempsey Construction Company of Tulsa; Smith Brothers Construction Company of Kansas City, Missouri; and Truman-Smith Construction Company of Eldorado, Kansas. Of these five the Kelly-Dempsey Company did not handle any work in connection with the original construction of defendants' pipeline.

At the time that this pipeline system was constructed the prevailing common labor rate, for example, was 40 cents an hour over the entire pipeline system. Forty cents per hour was paid in all of the states as the basic common labor rate. There was some common labor in Illinois that was paid 50 cents per hour. At the present time the prevailing wage level for common labor in the states where union labor would not be employed, that is in Texas, Oklahoma, Kansas, and Nebraska, is 50 cents an hour, and in Illinois it will average 80 cents an hour, as contrasted with the scales originally paid. The scales for skilled labor have advanced not quite in proportion with common labor rates, but they have advanced substantially, particularly in the Illinois section.

Our time studies and the data we have collected since 1925 disclose that weather conditions have a great deal to do with both the time that is required to construct the line and the cost of constructing the line. I know of my

own knowledge, and I also know by authority of the weather bureau that weather conditions were exceptionally good during the period when these pipelines were under construction. That portion of the line across the State of Iowa was mostly laid in the winter time, and that winter was the most open winter that had occurred in many years, and much more open that has occurred since in the State of Iowa, both as to temperature and as to rainfall and snowfall. The weather conditions, as reflected in any computations which we have made, have been reflected through the use of these time studies, and, of course, a time study made of construction where adverse weather conditions prevailed, and unusual weather conditions prevailed, would not result in data which we would be warranted in using as a basis of computation in future years. In other words, if, during the time of construction of this particular pipeline, adverse weather conditions had prevailed, the data which we obtained should not be interpreted to apply to average weather conditions. So we wanted to satisfy ourselves that the data which we obtained during the construction of that line was obtained during a period at least of average weather conditions. If this pipeline were about to be reproduced and other weather conditions prevailed than prevailed during the time when it was constructed, the figures we have would, I believe, be too
906 low from the standpoint of the cost of construction. I do not believe that they might also be too high. I am not a weather expert and I have not attempted to forecast any weather conditions. (Motion by Commission Counsel to strike the witness' testimony that the figures would be too low.) I do not know how many days of interruption that they had during the construction period. I know the temperature and rainfall conditions during the period of construction which are the things which mostly influence the time and cost. It is conceivable that if the line were constructed at some other time since 1931 the time would be longer or shorter, more expensive or less expensive. In compiling our unit cost and basing it as we have upon these time studies, we have naturally assumed the same weather conditions as existed at the time the studies were made and at the time the line was constructed, which were extremely favorable weather conditions. I mean by that I used the same time of construction period, the same number of days, and so forth, as that actually occupied by the construction of the line at the time it was built. I assumed

the same identical weather conditions which prevailed in 1930 and 1931, and they were extremely favorable.

In making up these time studies, or rather applying these time studies to the work which we have had in hand in connection with this assignment, I gave effect to such changes in methods of construction and the introduction of such new technological improvements as have come along since 1930 and 1931 and adjusted the labor to meet those changed conditions. We assumed in all cases that the most modern construction methods would be used.

I pass now to another phase of the work which I did personally, namely, the valuation of the lands owned by these companies. The valuation of land is a specialized subject. I was not familith with the value of the lands through the areas traversed by this pipeline system, and for that reason we employed the services of qualified land appraisers in the various areas in which this company owns land in fee. These appraisers were given a description of the land, a plat showing its areas, and were asked to appraise the land as of the date of the valuation and to furnish us certificates of appraisal, and those local realtors or appraisers were paid for their services.

I explained to them at the time I asked for these appraisals that we were not talking about land purchase for agricultural purposes but were concerned only with the small tracts, the size of those owned by these companies, for special purposes such as these lands have been utilized for since being acquired by these companies. I have not personally purchased that type of land. That is, I have not personally executed the purchase, but I have been familiar with purchases of the nature mentioned, and have seen the dates and records of purchases of land of this nature in numerous instances. By way of example I have seen the recorded costs of each purchaser of land owned and purchased by the Natural Gas Pipeline Company of America and the Texoma Company. In some cases I have also seen the recorded cost of the adjacent property used for agricultural purposes, such as ranches or other property. However, I would not say that I have seen such recorded costs in the majority of cases. (Objection for Commission counsel to the witness' qualification.) In general, my ability to testify on this subject arises only in that I have seen that information disclosed from the records of companies which I have examined, and through the connection which I have had with operating companies,

and knowledge of the purchases which have been made during that period of time. In a great many cases I have gained the knowledge in connection with studies calling for that information in the valuation of properties other than that of Natural Gas Pipeline Company of America and Texoma Natural Gas Company. I have accumulated this information over a period of about 20 years. For a period of 3½ years I was directly connected with an operating company at Bartlesville, Oklahoma as an employee particularly charged with making valuations and studies for rates, and other general engineering matters. Although I did not make the actual purchases of lands for that company I have knowledge of practically every such purchase in that period of time. Those transactions pertained to land adjacent to a transmission pipe line. (Objection of Commission counsel overruled.) In the majority of cases a pipeline company, a gas transmission company, or an oil pipeline company, is forced to pay a higher price in the acquisition of land than is the prevailing price of the acquisition of land for purely agricultural purposes, and there is a very good reason for that.

In the operation of a natural gas pipeline system or oil pipeline system the flow of the product handled depends upon the establishment of the pressure differentials at various points along the system. Those points are confined to a small area for the various compressor stations, and these stations must be constructed within certain small geographical areas. The site on which they are located must also afford a protection against damages from floods and weather disasters and must be located with the advantage of a permanent water supply. This narrows the available land down to quite a small area, so that it is necessary to make the purchase in this particular area, regardless of what price the company is eventually forced to pay for it. It is my observation that they almost always have to pay well for it.

907 There is another fact which must be considered there, and that is that these companies did not have the right of eminent domain in the State of Nebraska or in the State of Illinois, and it was impossible for them to condemn land for the purpose of stations. I do not believe they had that right in Iowa at the time they constructed the line, but I understood that they have it now although they have not exercised it. The farmer who owns a 160-acre farm or a farm of a greater or less size, or a rancher who

may own a substantial tract of land which he uses in connection with the grazing of stock, may or may not be willing to sell 30 or 40 or 60 or even 80 acres, as in the case of the Fritch station, off his farm or off his ranch for the conduct of an operation such as that of these pipelines on these station sites. (Objection by Commission counsel overruled.) I can think of two or three reasons why a farmer would not be willing to sell 20 or 30 acres off his farm for a station site for a pipeline company at the value of that land for agricultural or ranching purposes. The first is that his whole economic scale of farming is predicated on dividing the farm into pieces, devoting 15 acres to his cow pasture, another 15 acres to the cultivation of wheat, and that fits into his balanced scheme of farming. Now if the pipeline company or anybody else attempts to buy his cow pasture, he is naturally going to charge more per acre for the cow pasture than he would for the farm as a whole because it would split up his whole scheme of operations. It would leave him less land than he has been utilizing in the making of a living. Such a situation is similar to what is commonly known as severance damages.

The second reason is that the construction of any natural gas pipeline system presents a certain hazard to persons living in the immediate vicinity, and if I were a farmer I would not want a natural gas pipeline company compressor station on one corner of my farm.

I made use of the figures I obtained from these various boards and realtors who made the appraisals and who have advised me of their judgment as to what would have to be paid for lands to be used for the purposes of these pipelines. They are the figures that we have used in setting out the reproduction cost of these lands in fee and they are incorporated directly into our report. In total these reproduction costs are below the actual costs of the lands. I think that one or two parcels may have been valued in excess of their cost, but in total they are below the actual cost to the companies. As to ascertaining the present day cost of the rights-of-way for the pipeline and the telephone system, and any other rights-of-way that we found to be owned and used in their operation, we first made a careful inventory of the actual right-of-way contracts owned by the companies. We consulted the cost records of the companies and determined the cost incurred for the purpose of these rights-of-way, together with the cost of acquisition, that being the cost of the man who went out and made the

purchases and the cost of abstracting the agreements and recording the instruments, the traveling expenses, legal expenditures, and items of that nature.

The cost of acquiring pipeline right-of-way has steadily increased ever since the first pipeline was constructed. It has no depression at all. Every additional pipeline that is constructed any place in the country makes it more difficult for the next pipeline to secure rights-of-way on anything like a comparable cost, and for that reason we employed the services of an experienced right-of-way man, a man who had actually purchased a great deal of this right-of-way owned by these companies and who had actually been engaged in that type of work since that time. We sent him out over the pipeline system to interview farmers, land owners, farmer organizations, realtors, banks, and to
908 report to us the cost of acquiring similar contracts for right-of-way at the present time.

He covered the entire length of the line and all the rights-of-way from Joliet clear to the Texas Panhandle. He reported his findings and determinations to us, and we have used these determinations and incorporated them in our report.

As to the costs of securing or making the actual purchases, we determined the relative wage scale paid to right-of-way agents at the time the line was constructed and at the present time and have increased those costs in that proportion.

A right-of-way is just an easement as I understand it, and the land occupied by the right-of-way reverts to the farmer ordinarily, as soon as it is no longer used for the purpose for which it is granted. The pipeline company does not buy the land itself but merely the right to cross it and lay, maintain, and operate a pipeline in the land.

In addition to the mere easement and the other costs involved in the acquiring of a right-of-way, a very substantial portion of the total cost is represented by payments for the damage to the crops during the construction of the line.

I have seen right-of-way contracts covering the acquisition of rights-of-way extending back as far as 1886, or 1881, and I have seen rights-of-way contracts in that same immediate vicinity acquired in 1936, 1937, and 1938. In one particular area that I have in mind I have seen an executed right-of-way contract providing for 5 cents per rod for the right-of-way, and I know at the present time that company

would be exceedingly fortunate if they could purchase a similar right-of-way for $5 a rod. This remarkable change in the cost of obtaining rights-of-way is due principally to visiting between the farmers. When a pipeline system sets out to secure rights-of-way, in order to obtain it in the most economical manner they will send a large force of agents out to make these purchases. The first purchase that the first agent makes from John Jones, in the next half hour has been told to Bill Smith, who owns the adjoining farm, and frequently the price at which the first man sold is exaggerated, and so the news spreads. The fact is, it soon becomes common knowledge that a pipeline is about to be laid in the territory, and the farmer will remember that two years ago he got $2 a rod from some other company, or somebody else got $2.50 from some other company. Thus the price goes up year after year.

For this reason to acquire rights-of-way we send out large forces in order to try to close it up quickly, but they do not always succeed in closing it up with everybody. There is always some fellow who is harder to deal with than another fellow. Here again, in the states of Nebraska and Illinois these companies do not have the right of eminent domain, and it is impossible for them to condemn land for right-of-way purposes. That means eventually they must meet the price demanded by the landowner. There is frequently dissatisfaction among the neighbors when one neighbor receives more than the general run of his neighbors receives.

909 Of course the construction company or the company building the pipeline has the option of taking the line around some other way and keeping off of the land of the man who is hard to deal with, but that usually costs more than it does to pay the landowner his price. When he is paid a higher price, it is more difficult to deal with his neighbors when you come back to them for another right-of-way. That is the way it works out in practice. At the time this line was constructed a general expedition was conducted for the landowners, and they were taken down over sections of the line already completed to show them that the construction of the pipeline across the farm was not going to utterly destroy the whole farm. That was necessary before any arrangement of anything approaching a reasonable price could be made.

The term "overheads" is used to include certain elements of cost, always entering into the construction of any

projects, that are of a general nature and are difficult to allocate to specific items of property. The general overheads which we have included in our report consist of engineering and superintendence, organization and law expenditures during construction, taxes during construction, administration during construction, preliminary operations, and interest during construction.

By "preliminary operations" is meant the expense of tuning up the system and placing it in a position to operate, together with the necessary costs of carrying such portions of the investment as must be purchased at the start throughout the construction period, and in this latter category I was thinking particularly of the leaseholds—gas leaseholds—owned by the company that must be obtained in advance of the drilling of wells and must be kept alive throughout the construction period by the payment of rentals to the landowner.

We do not assign to each unit, to each pump, engine, compressor unit, building on the compressor site, or any other unit of inert physical property which has gone into the construction of the pipeline, its proper proportion of the engineering expense, legal expense, interest and taxes, and various other things above mentioned, because it would involve a tremendous amount of detailed work and would accomplish nothing in the long run. The method we have pursued washes out with the same result and results in the same amount.

If you will refer to page 39 of Exhibit 125, the method of calculation of these overhead costs is indicated on this page for the property of Natural Gas Pipeline Company of America. "Engineering and superintendence" we have calculated at 4% of the reproduction cost of the property requiring engineering work in connection with its construction. There are certain items of property owned by this company which require no engineering in their construction or purchase. These are such items as tools and laboratory equipment, furniture and fixtures, automobiles and trucks, so we have eliminated them from consideration in calculating the engineering and superintendence. We have calculated the organization and law expenditures during the construction at .3 of 1% of the applicable accounts; taxes during construction at .4 of 1%; administration during construction at 1.5%; preliminary operations at .6 of 1%; and interest during construction at 6¾%. This is set out in detail to show just what figures those percentages apply to

on page 39. The organization and law expenditures apply to all construction accounts but not to certain other overheads which we have calculated.

910 The item of engineering and superintendence, which is the first item enumerated on page 39, is put in at 4% of the total of all costs except the costs involved in Accounts 1013, 1014, 1015, and 1016. I determined that such costs would amount to 4% of the costs to which that percentage was applied in the following manner: In the first place, engineering and supervision in the construction of a project like this can usually be obtained from engineering organizations which specialize in this sort of work. There charges for complete engineering and supervisory service in a project of this kind would probably cost in excess of 5%. It is usual to make contracts of that kind. That percentage, in the case of a property such as this, I believe, would be somewhat reduced because of the project's magnitude. In other words, that service on a small project might run as high as 10%. On a larger project, when it is related to a percentage, the percentage would be reduced, and I believe if this company should contract for complete engineering and supervisory service for the construction of the system on the basis of 4%, they would make a very good deal.

In addition to that, this project was built originally almost in the same form in which it now exists. The additions since the time of original construction have not been extensive, consisting for the most part of additional compressors in the compressor stations.

The company kept a very careful record of all expenditures for engineering and supervision during the construction period, and we made extensive analyses of these expenditures, resolving them into their different component parts, and we have used that as a basis for our computation. In certain instances, where we felt that those expenditures would be increased or decreased at the present time, we have adjusted them accordingly.

We have thought it necessary to make adjustments where labor was involved primarily. In other words, we made a comparison between labor rates, or wages for technical labor, at the time the line was constructed and at the present time, and for the unskilled labor that has entered into these costs. We also made a comparison of traveling expenses, which are a considerable portion of these costs. We came to the conclusion that traveling expenses at this

time are approximately the same as at the time the line was constructed. We then added all these costs, adjusted or otherwise, together and found that they would approximate the figure of 4%, and we rounded it out to an even 4%.

As a matter of fact, I know that there were services performed during the construction of this line which were never charged to these companies or never paid for by these companies. Those services were rendered by organizations participating in the construction of the line that owned a portion of the line, and they simply donated these services to the defendants. We have not attempted to carry these costs incurred by the participants into the cost of reproduction in detail. Insofar as that type of service would be rendered in reproductions of the property as of today they do not appear in the engineering and superintendence overhead except as they may be reflected in the difference between the actual amount recalculated and the rounding out to the four per cent. It is very slight amount.

The 4% figure, applied to the property of both defendants, which required engineering, amounts to $1,958,000. My calculation of the actual engineering necessary for the construction of this project and predicated to a very large extent on their actual costs amounts to $1,900,000, a difference of only about $60,000. This would be 3.98%, or something like that, instead of 4%.

911 In arriving at the next item, organization and law expenditures during construction, which is .3% of subtotal 3, we worked out the cost of organizing these two corporations and licensing them to do business in the states where they are licensed. The organization costs include the expense of incorporating both corporations in the State of Delaware, where they are incorporated. There are certain fees in connection with that incorporation which must be paid. The organization costs include the licensing of the Texoma Company to do business as a foreign corporation in the State of Texas and in the State of Oklahoma, and the licensing of the Natural Gas Pipeline Company to conduct business as a foreign corporation in the states of Oklahoma, Kansas, Nebraska, and Iowa. They include also license tax payable to the State of Iowa for permit and the attorneys' fees for organizing the two corporations, the cost of engraving and signing the stock certificates, and the revenue stamps on the original stock issue, all of which totals approximately $31,000.

The law expenditures include the cost of the companies'

regularly constituted legal department during the construction period, together with the cost of obtaining certificates of convenience and necessity in the State of Kansas, the expense incident to securing a pipeline permit in the State of Iowa, the legal expense necessary in securing the permits across navigable streams, and that which would be necessary, I believe, at this time in obtaining a certificate of convenience and necessity from the Federal Power Commission, which total, as we have calculated them, approximately $155,000. This amount added to the $31,000 of organization expense would make a total of $186,000, which we have rounded out to .3 of one percent, resulting in the inclusion in this amount of $154,000, or some $35,000 below our actual calculations.

We made no allowance in this calculation for legal services in connection with examining titles to the property owned by the company or anything of that sort, other than what would be normally done as a routine matter by the regular legal department of the company. I made the assumption that the company would have a legal department during its construction period, just as it did when the construction was actually carried on. I made no assumption as to the expense of examining the titles to the leases, because we haven't included the gas leaseholds in any way in this valuation. There is a considerable cost for examining all titles in connection with right-of-way contracts which are included in the report as a part of the cost of the right-of-way.

The next item appearing on page 39, for which I am primarily responsible, is that of taxes during construction, and I have placed it at .4% of subtotal 3. In arriving at that figure we have made the assumption that if this property were to be reproduced at this time it would require approximately the same construction period as it did when it was actually constructed. I have used the same assumption in all of these overhead charges. During the construction period the taxes which the company would have to pay should be included as a part of the cost of the project, and there are four general classes of taxes which these companies would have to pay. The first is the ad valorem tax, the second the franchise taxes, the third, special taxes such as the pipeline inspection permit in the State of Iowa, and the fourth, Federal capital stock tax.

912 In calculating the amount of ad valorem taxes we made the necessary assumption that assessment rates

and tax rates would be the same as those which prevailed on June 1, 1939, and depending upon the assessment dates in the various states would depend the period over which the companies would be taxed during the construction period. The assessment dates are not all the same in all states. For example, in the State of Illinois the assessment date is April 1, and so during the first year of the construction period, when no property was constructed in Illinois, there would be no tax to pay in the State of Illinois. In the second year of the construction period the tax in Illinois would be assessed only on such property as was installed or completed by April 1.

In connection with the gas wells drilled in the State of Texas, we considered that if this property were to be reproduced, a drilling program would be inaugurated which would drill the present wells owned by the company during the period when the pipeline system and the compressor stations were being constructed, so that at the completion of the pipeline and compressor stations the wells would be drilled and the company would be ready to start off furnishing gas service. In other words, we reproduced the whole property as of the period of the actual construction of the original pipeline.

We reproduced the whole property from a date beginning the same month of the year as the original line was commenced to a date corresponding to the same month in the following year at which the line was completed. We calculated the ad valorem taxes which would be necessary to pay during this construction period, which approximates a year and a half, at $176,500, and the franchise taxes which it would be forced to pay during this construction period at $17,800. The special tax in Iowa for the pipeline inspection permit we calculated at $3,092, and the Federal capital stock tax we calculated at a minimum amount of $4. The provisions with respect to Federal capital stock have been changed by the last Congress, and at this time it would not be necessary, we believe, to declare a stated value of the capital stock of these companies, which would avoid the payment of excess profits tax, and therefore we believe we could declare only a nominal value during the construction period for the stock of these two corporations.

The total taxes during the construction period we have computed as $199,000, and we have rounded that out to .4 per cent, which, when applied, amounts to $205,376, or within $5,000 of the calculated amount.

The next item is "Administration during construction," listed at 1.5% of subtotal 3. In calculating this item of expense we have been guided primarily by the actual experience of the companies during the period of construction. Administration during construction includes amounts calculated for executive salaries during construction, clerical salaries, office supplies and expense, insurance, rent, telephone and telegraph expense, and items of that nature. We determined from an analysis of the records of the company just what those expenditures were at the time of construction for the two companies and have adjusted those expenses reflecting conditions as of June 1, 1939. We have calculated these expenditures to be approximately $774,000, and applying the percentage of 1.5 it results in the figure which we have included in our report of $770,000 for the two companies.

913 I might say here that in the calculation of all these overheads we have considered the two companies as one and have made the calculation for the combined companies and then divided it between the two companies on the basis of the physical properties of one as compared with the other. The figures which we have given are comparable to the sum of the figures shown on page 39 for the Natural Gas Pipeline Company and similar calculations are shown for the Texoma Company on page 65.

The next item of an overhead nature we have included under the caption "Preliminary Operations," calculated at the rate of .6 per cent. In calculating this amount we again were guided by the actual experience of the company. We determined that from the time the physical property was completed over the various portions of the system until gas was first run through the line there was a total expenditure of $142,000. Now this expenditure was occasioned primarily by what we call tuning up the system, turning the engines over and making sure that they operated satisfactorily, filling in small gullies along the pipeline system, and in general cleaning up and tuning up the whole system and putting it in shape for operations. During that period there was a slight credit for gas sold, which we have deducted, or applied it as a credit against this expense. There is also included in this allowance for preliminary operations the expense of rentals on the gas leases during the construction period. The leases would have to be assembled, and were assembled, prior to the drilling of any wells, and we have predicated that expense

on the premise that the company owned and carried the exact amount of acreage which they had on June 1, 1939. We analyzed the lease contracts and determined that the average rental per acre which would have to be paid during the construction period was 55 cents an acre. This would have to be paid over a period of two years. We applied as a credit to that rental the royalty from gas used in drilling the wells, which amounts to approximately $12,000, making a total or net charge for the lease rentals during the construction period of $155,000. This added to the expense of tuning up the system makes a total of $297,000, which we have rounded out to .6 per cent, in the amount of $308,000.

The other item remaining is "Interest During Construction." In determining the amount to be calculated for interest during construction we have again assumed that in the reproduction or reconstruction of this pipeline system the same period of time would be required as was required in the original construction. That is a period of approximately 16 months. So we went to the actual construction expenditures of the companies during the construction period and found that during the first month of construction there was 1.58% of the total expenditure made. During the second month there was 5.71%; the third month, 14.32%; and so on throughout the various months of the construction period. On this basis we believed it was reasonable to assume that in the reconstruction of the system the money would be spent at the same rate, and so we took the total of the reproduction cost of those items requiring interest during construction, which happens to be the subtotal that is indicated on the page at which you are looking as subtotal 4. That subtotal for the two companies amounts to $52,781,710, and applying the ratio in which the money was spent, or the rate of monthly expenditures of funds, to this amount we determined that in the first month of construction there would be a total expend-
914 iture of $833,951; in the second month the expenditure would be $3,013,836; in the third month, $7,558,341; and so on during the construction period. The expenditures during the fourth month were $6,286,302; the fifth month, $3,589,156; the sixth month, $4,797,857; the seventh month, $5,183,164; the eighth month, $3,837,230; the ninth month, $3,610,269; the tenth month, $4,380,882; the eleventh month, $3,684,163; the twelfth month, $2,047,930; the thirteenth month, $1,382,881; the fourteenth month, $717,831; the fif-

teenth month, $791,726; the sixteenth month, $496,148; the seventeenth month, $337,803, and the eighteenth month, $232,240.

In making this calculation we found that gas was actually being delivered after the sixteenth month, and the expenditures in the seventeenth and eighteenth months were largely carry-overs, representing the lag between construction and final payments when entered on the books. So the expense in the first month would draw, or should have interest calculated on it for a period of 16 months; the expenditures the second month for a period of 15 months, and applying an interest rate of 8% per annum results in a percentage of 10.67% of the expenditure during the first month. This percentage of expenditure when multiplied by the portion of the funds expended during the first month results in an amount for interest during construction on that first month of $88,983.

The calculation was then extended for each of the succeeding months and resulted in a total amount of $3,533,059, which is an overall percentage of 6.69%. We rounded that figure out to 6⅔%, which resulted in an amount of $3,520,540, as compared with $3,533,059, as actually calculated. In rounding it out we reduced it from 6.69% to 6.66⅔%.

I used the rate of 8% per annum after discussion of the matter with Mr. Hamilton and after consideration of the rate which these companies had paid as interest for funds during the construction period, coupled with the fact that interest during construction is merely a portion of the return on funds invested during the construction period and on which the investor is deprived of any earning unless it is added to the rate base. I believe that the amount of 8% per annum is a reasonable figure. In other words, through the calculation of interest during construction we have simply made provision for the money which was invested in this enterprise to yield compensation during that period of construction at the rate of 8%. The money was idle during the construction period so far as affording any return to the investors was concerned. The company actually paid 8% for the money that it used in the construction of this pipeline. This interest was paid to the participants furnishing the funds, who later became the security holders of the company.

By "Working Capital" is meant funds which an operating company has tied up in the conduct of its business and which are currently kept on hand. The operating com-

pany would be deprived of any return on these funds unless they are included as a part of the rate base. It is usual, therefore, to include the amounts tied up in working capital as a part of the rate base. We arrived at the proper amount to be set aside as working capital for these companies from the actual experience of the companies as of June 1, 1939. Defendants employ working capital in five different ways. First they have funds currently
915 invested to meet current operating expenses over that portion of time between which the services are first rendered and payment is received for those services. I went through the payments received from the sale of natural gas for a period of two and one-half years and found that there was an elapsed time of an average of 49.22 days between the beginning of service and the time when the check was received in payment for that service in the office of the company. That means that these companies have to provide cash for operating expenses and have that cash currently tied up in the conduct of the business for a period of 49.22 days.

I then determined which operating expenses required cash to be invested currently, excluding those expenses which were not paid until sometime after they were incurred, such as Federal income taxes and items of that nature. I also excluded the item of regulatory expense because that is a non-recurring expense, and while it takes working capital at this time, it will not require any working capital after this case or similar cases are disposed of.

I excluded also from consideration the purchased gas, because the gas which the company purchases is not paid for until after cash is received from the customers to whom the gas is sold. We found that applying the factor of 49.22 days divided by 365 for the entire year, and taking the operating expenses over a period of years, that they had currently invested to meet operating expenses as working capital $348,000.

They also had cash invested in the way of minimum deposits in banks to maintain these banking connections. No bank will handle the volume of checks which these companies issue in the course of a month without requiring a minimum deposit to be left on hand in that bank, and I determined from the cash balance of the company that that minimum approximated $150,000.

The third portion of this working capital is the cash currently invested in prepayments or expenses paid in ad-

vance of actual charge. These prepayments are for the most part prepaid premiums on insurance policies, and I found that they had on the average $69,000 currently tied up in such prepayments.

The fourth item is that of materials and supplies which the company currently keeps on hand for making repairs, minor extensions, and things of that character. They might be termed warehouse stocks. I determined that the average amount which they had in warehouse stocks amounted to $379,000.

The last item is the gas which is currently in the lines and which is there at all times and must be either purchased or produced originally. The company is never able to sell it until it finally ceases business, and that item for gas in the lines is carried on the companies' balance sheets at $27,900.

The total of these five items amounts to $974,638, which I have rounded out to $975,000 as the necessary amount to be allowed as working capital. From my experience in valuation work I find that this is a relatively low working as compared with that employed by other pipeline companies.

916 I have a break-down of the part of this expense which has been allocated to Texoma Natural Gas Company on page 65 of the same exhibit. The total figure which I gave of $975,000 applies to both companies, and it has been distributed between the two companies in the ratio of their physical property. These break-downs are found on pages 39 and 65. The combined figures are shown on page 1, which is a summary of the total figures found for both companies.

In general the structural overheads have been depreciated in the same ratio that the physical property has been depreciated. We find it proper to depreciate such charges as engineering services, legal services, administrative services, interest, taxes, and these other items of overhead because they are primarily labor charges, and we believe they should be depreciated the same as the other labor entering into the construction of the pipeline, and for the further reason that if this company is to be amortized, so to speak, over its useful life, provision must be made for the amortization of these amounts. In other words, these charges are merely a part of the cost of the physical property and have to be depreciated along with the other costs of the physical property when you apply the depreciation to that

cost and if they are related to certain units of property that should be retired along with the retirement of those units. We have not depreciated the overhead item of organization and law expenditures because this is a corporate expenditure and does not have to do with the physical property and would remain as long as the company was in existence in its corporate form. Since working capital is not an item of fixed capital, it is a current asset, it is not one of the costs of reproducing and is therefore not depreciated.

On page 1 I have set out in this exhibit the reproduction costs of the items which I have discussed and for which I have stated I was responsible in the making up of this exhibit. On this page are shown also the final figures representing the reproduction cost new of the two properties and the present value of the two properties. The lands in fee and rights-of-way are shown in lines 1 and 2 under the caption numbers 1000 and 1002, respectively. Those numbers correspond to the fixed capital account numbers used by the company. Toward the bottom of the list no account numbers appear. That is due to the circumstance that the company has no account number for engineering and items of that kind and distributes those items currently over the items of property to which they apply.

Based on my experience and on the work I have done in assembling the figures which have been set opposite those items lands in fee, rights-of-way, engineering and superintendence, and the other items following it in the list as shown on page 1, it is my judgment that those figures represent the reasonable amounts that would be involved for those items in the reproduction or reconstruction of the property.

Questions by the Examiner.

I did not personally select the appraisers but I arranged for the selection of them in the various districts. In answer to your question as to whether I know if they were qualified, I can only answer by stating that they were employed with the understanding that they were qualified and competent.

The appraisers who furnished me the figures for the lands in fee and rights-of-way were employed directly by
the superintendents at the various stations of the com-
917 pany, who were each instructed to employ the most
competent men that could be obtained. Ordinarily we

would ask for appraisals of similar property to be made by the appraisal committee of the local real estate board; but in this territory where these lands are located there are no real estate boards. These men were regular or professional appraisers. I did not talk with the appraisers directly, but I corresponded with them. I took their certificates and worked from the latter. It was a paper job in that sense. I just added up the total of their certificates to arrive at my total figure. I have in my possession all of these certificates received from these appraisers. They are available. If it had been possible for us to obtain the services of one appraiser who we felt was expert enough to value the company lands and rights-of-way from Chicago to the Texas Panhandle, we would have done so. We actually employed in the neighborhood of fifteen.

I have here a certificate of one of them, Robert Ricks, an appraiser of Amarillo. I do not have here the qualifications of each one of these appraisers, but I do have the qualifications of Mr. Ricks. Some of these appraisers probably didn't furnish their qualifications. A part of this territory is pretty far out in the sticks. I do not believe the company has in its files any statements as to the qualifications of these other fourteen. (Objection by Commission Counsel to qualification of witness overruled.)

Direct Examination Resumed by Mr. Morgan.

The mechanical work of applying the amounts deducted for depreciation as reflected in this exhibit was done by our force. The amounts of depreciation deducted were determined and furnished us by Mr. P. McDonald Biddison, who was retained by the defendants to make a study of existing depreciation and report on that subject. He furnished us the amounts in dollars.

The first three pages of this Exhibit 125 are a letter of transmittal explanatory in general of the work we did. These pages are followed by a photo map indicating the system of these two companies. This map is followed by a table of contents. Page 1 of the exhibit is the final summary indicating the property of both companies. It shows the reproduction cost new and the present value after the application of depreciation figures furnished us by Mr. Biddison. The total of the two columns is shown at the foot of each respectively.

Page 2 is a similar summary of the property of the Natural Gas Pipeline Company of America only, and page 3 is a similar summary of the Texoma Natural Gas Company only. In other words, page 1 is a summation of pages 2 and 3.

Beginning with page 4 is what we term the detailed summary of the property of Natural Gas Pipeline Company of America and is arranged by accounts corresponding to the fixed capital accounts maintained by the company on its books. These detailed summary sheets show the reproduction cost new of each major item of property or group of items, the depreciation deducted, which was determined by Mr. Biddison and furnished to us, and the present value, which is merely the depreciation subtracted from the reproduction cost new. This detailed summary extends from page 4 to and inclusive of page 38 for the property of Natural Gas Pipeline Company of America. Page 39 is a further summary showing the manner in which the various overheads have been applied and calculated as far as the Natural Gas Pipeline Company of America is concerned.

918 Beginning on page 40 and extending to and including page 64 is a similar detailed summary covering the property of the Texoma Natural Gas Company, in which the determinations of depreciation made by Mr. Biddison are shown and deducted from the reproduction cost new in arriving at the present value. Page 65 is an additional summary similar in form to that shown on page 39 and covering the property of the Texoma Natural Gas Company, showing the manner in which the various overheads have been calculated and applied.

The detailed portion of the valuation begins on page 66, and all of the ensuing pages of the report indicate the details of property, together with the unit cost and reproduction cost new of the particular item.

On page 1 I call attention to the fact that under the caption "Present Value" the total is $54,410,492. That figure in my opinion and in my judgment represents a reasonable reproduction cost new of the physical elements entering into this pipeline system, viewed as inert elements or component parts and not as parts of the whole, less the applied depreciation worked out and furnished to me by Mr. Biddison. I point out again that these figures do not include the item of gas leases.

Cross-Examination by Mr. Booth.

With respect to the items of general overhead which I have prepared, I intended to state the principal considerations which entered into my judgment in arriving at the amounts I estimated for each of the items of general overhead. So far as I can recall at this time I have not omitted any principal factor which I considered in arriving at those items in my testimony this afternoon.

Cross-Examination by Mr. Slaff.

I will furnish a list of cases in which I have testified in the last ten years on valuation proceedings and rate cases.

Redirect Examination by Mr. Morgan.

Referring to Mr. Booth's questions, I have the working papers and notes that were used by me in assembling the figures for these items of overhead concerning which I have testified. I have the details of all calculations which I made. I am willing for Mr. Booth or his experts, or Mr. Slaff or his experts, to examine these working papers and ascertain just how I arrived at those figures. They will be available at any time they wish to do that.

Questions by the Examiner.

I had one man go along the entire pipeline and have interviews with farmers, farm organizations, and so forth, with regard to the cost of acquisition of rights-of-way as of June 1, 1939. I cannot tell you the exact number of days that agent was out, but he was out a considerable time. The number of days he was engaged in this work can be ascertained very easily in Chicago. He was out a considerable time in 1938 and again in 1939. I will have that data available at the time of cross examination.

919 In estimating the cost of acquisition wherein we considered wage scales and so forth, we used the same system of acquisition of rights-of-way as was actually used by the company. I contemplated the same method of acquiring rights-of-way. I attempted to use the same number of man hours, assuming that the difficulties that would

be encountered would be the same as those which were encountered.

This item of crop damages is a lump sum determined once and for all, with the exception that in subsequent years when repairs are necessary and the crops are destroyed, the farmer is reimbursed for all damage of that kind. That is charged as current operating expenses. It happens quite frequently that crops are damaged because of repairs made after the line is in operation. I did not use any figure in this cost of acquisition of rights-of-way to represent increase in the difficulty of acquiring rights-of-way today.

(September 1, 1939)

Redirect Examination Resumed by Mr. Morgan.

In my examination yesterday I was asked concerning the number of contractors with whom I checked labor costs up and down this pipeline and the number who were engaged in the building of the pipeline. I gave the names of five contracting firms whom I had consulted on this point and stated that there were four of these contractors who had a part in this pipeline construction. I was mistaken. I should have said there were three. The other one which I thought at the time I testified did take part in this construction work, but which it turned out did not participate, was Truman Smith Construction Company. They are a large pipeline construction organization and have been doing work in that immediate vicinity at this time. They have been so engaged for several years. I believe they made a bid on a part of the construction of this line, but I am not certain on that point.

Questions by the Examiner.

I am certain the appraisers who appraised this property actually viewed it. I didn't accompany the appraisers, and I have only correspondence from them, but that correspondence would lead me to believe that in every case they did view the property.

Redirect Examination Resumed by Mr. Morgan.

As I stated during my testimony yesterday, I was for a period of approximately three and one-half years directly

connected with an operating natural gas organization. That organization now comprises the Cities Service Gas Company of Bartlesville, Oklahoma, and my work with that organization was of such a nature that I was familiar with almost all of the activities of that organization. I was familiar with several tracts of land which were purchased by that company during that period of time, knew their costs and the location of the land and the purpose for which it was used. Since that time I have also been quite familiar with the operations of that same company and have made two complete detailed appraisals of all their property, including their lands in fee.

Questions by the Examiner.

I have noted in my experience in that connection that we were not able to purchase land for our pipeline pur-
920 poses at the prevailing agricultural prices. This is true in a great majority of cases. It is true with respect to the Cities Service Gas Company at Bartlesville. That is a transmission company and not a distributing company. It is one of the pipelines which transmits gas out of the Texas Panhandle.

My statement concerning the difficulty of obtaining land from farmers or ranchers experienced by the defendants at the time they were getting the land for the construction of their pipeline, including station sites, was based on correspondence which I have seen in the files of the company. I saw this correspondence during the last year or year and a half. It consists of letters in the files that were written as of the time the pipeline was being constructed and dealing directly with the then going on negotiations for the acquisitions of the land. I have also had this information confirmed in my conferences with offices of the company who know or should have known of the difficulties, because they were associated with the company at the time.

921 J. L. WILLARD, a witness for the defendants testified:

(September 1, 1939)

Direct Examination by Mr. Morgan.

My name is J. L. Willard. I reside at Summit, New Jersey, a suburb of New York City. My place of business is at 60 Wall Tower, New York. I am at present and have been for the past 14 years associated with F. C. Hamilton.

I went through the public schools in the city of Denver, and later attended the University of Colorado, finishing there with a Bachelor of Science degree in civil engineering in 1922. During odd times while in the university, I was employed by the Phelps-Dodge Corporation in their coal camps in Dawson, New Mexico. In that work I was with the mining engineering department, and was engaged in survey work of an underground and surface type, and also in making estimates of coal recovered and expected recoveries.

Following my graduation I was employed by the Empire Gas & Fuel Company at Bartlesville, Oklahoma, and was connected with the civil engineering department. I was employed by this company from the summer of 1922 to the fall of 1925, during which period I covered the entire territory of all their gas pipe lines, oil pipelines, oil production and refining properties. By all their territory I mean the territory in the Mid-Continent field.

At the beginning of my employ I was placed in charge of survey parties for the location of pipelines, both oil and gas, tank farms, oil pumping stations, gravity oil gathering systems, location of oil and gas wells, and was also connected with the follow-up construction of gas and oil pipe lines. During the construction of these pipe lines I did considerable checking of materials that went into the project, and after the completion of the project, quite often I had charge of a party making a complete field inventory and check of all of the materials that went into the project. Later in this employment I was engaged in making estimates of the cost of the pipelines, including lines from the Oklahoma district to Denver, Colorado, and also to St. Louis, Missouri. I was engaged in making cost estimates of various accessory equipment to gas compressor stations. These estimates of cost of constructing these pipelines

included all of the costs involved in the construction of the pipeline and the necessary appurtenances used in connection with its operation. That, in a general way, is practically the same as the work of making the valuation of a pipeline after the project is completed. It is necessary to obtain quotations on all materials that go into the project, and estimate labor performances from knowledge of previous pipeline construction.

In the fall of 1925 I was employed with the Cities Service Company, and associated with F. C. Hamilton in the valuation and rate department. I have been engaged in that work from then until the present time.

922 After a preliminary experience of two or three years, I was on the road almost constantly from 1925 until 1936 in charge of appraisals on gas properties located at Denver, Colorado, two valuation jobs in Bartlesville, Oklahoma on the Cities Service Gas Company, a job on the Kansas City Gas Company located at Kansas City, Missouri, the gas properties of the City Light and Traction Company at Sedalia, Missouri, the East Tennessee Light & Power Company at Bristol, Tennessee, the Danbury Gas & Electric Company at Danbury, Connecticut, and was called in, in a consulting capacity, on work on the Republic Light, Heat & Power Company in Buffalo, New York, and the Arkansas-Louisiana Gas Company at Shreveport, Louisiana.

In addition to these valuations on gas properties, I have been engaged in valuations on electric, street railway, water, ice and cold storage projects. The major of these properties include those located at Cleveland, Ohio, the property of Ohio Public Service Company, which covers a large portion of the central and eastern part of the state of Ohio, the Toledo Edison Company located at Toledo, Ohio, the entire electric property of the Public Service Company of Colorado at Denver, Colorado, properties of the Empire District Electric Company, the Lawrence County Water, Light and Cold Storage Company, the Toledo & Indiana Railway, the Lake Shore Power Company, and numerous other properties.

I have made estimates the appraised value of which ran in the neighborhood of from $800,000,000 to $900,000,000. The portion of that of which I have had direct charge—sometimes individually and sometimes in association with other men of our department like Mr. Eastman and Mr. Stoddart, and always under the direction of Mr. Hamilton

—I would say of that total I have been in direct charge of approximately $600,000,000.

I have made appearances before utility commissions, courts, and other tribunals in connection with these valuations matters with which I have worked. I participated in hearings of the Cities Service Gas Company before the Public Service Commission of Kansas in 1931 and 1932, not as a direct witness but as an accessory to the witness. I also appeared in the same capacity at a later hearing on that same property in 1934. I was connected with two hearings before the Public Service Commission of Missouri on the properties of the Empire District Electric Company and the St. Joe Railway, Light, Heat & Power Company. I was present at a hearing before the Interstate Commerce Commission recently held on the properties of the Empire Pipeline Company, an oil transmission company of the Cities Service Oil Company. I testified before a district court in the city of Fort Collins in a condemnation suit brought by that city against the Public Service Company of Colorado.

In 1936 I was sent into the New York office to take charge of the valuation crews who had jobs going on in various sections of the country at odd times. I have visited and consulted on these jobs in many locations. My work has involved the making of reports for attorneys in their work to obtain new securities before the Securities and Exchange Commission, and also before the Ohio Public Service Commission. That was valuation work. I have also been engaged in the establishment of rates for both gas and electric service in various sections of the country.

923 I have had to do with the valuation studies compiled under the direction of Mr. Hamilton on the properties of defendants. In conjunction with Mr. Eastman and Mr. Stoddart, under the supervision of Mr. Hamilton, I was engaged for a period of five and a half months in 1938 in obtaining a complete physical inventory, together with a pricing of that inventory on the properties of the two defendants, and again in 1939 for a period of three to three and a half months I was engaged in that same work in bringing the previous 1938 data down to date.

I was in Chicago, with the exception of a few days, during the entire period of both of these valuations in 1938 and 1939, and had under my supervision a group of men varying from ten to twenty.

It was my duty to organize the personnel that was

brought into Chicago to compile this data. In conference with Mr. Eastman I decided that certain men would take charge of certain phases of the work, some going into the field to make a complete physical inventory of all the visible property in the field. After all of the records in the office and the data taken from maps of the pipeline, maps of all compressor stations, meter and regulator stations, had been thoroughly examined, these men were sent into the field to make additional inventory of all of the property in the field and check that inventory with the data that was obtained in the office, and to make any adjustments that were found necessary due to any small changes that might have been made in construction work around buildings or on other small maintenance jobs that had not been properly reflected on the maps from which we obtained the data in the Chicago office.

We made a complete inventory of all of the accessible or visible physical property of these two pipelines. During the field check we had men inventorying, after visiting all of the gas wells in the Panhandle Field, all of the physical property in connection with the top fittings of the wells, fences, signs, meter and regulator runs, together with the meters and regulators, the buildings housing the equipment, and from there traveled to the Fritch compressor station and tabulated all of the equipment in connection with the compressor station, the gasoline plant and the dehydration plant, all of the cottages, warehouses and other items of a physical nature at that location. Our men visited all of the intake meter runs on the various gathering lines. They visited the river crossings where the gates on the headers could be observed, and then traveled from Fritch northward, covering all of the stations in the states of Oklahoma, Kansas, Nebraska, Iowa, and Illinois. I don't want to convey the impression that one party covered all this territory. We had several parties in the field, some working south on the line from the north end and others working north from the south end.

These parties were composed of members of our organization who were employees of long standing. All of those men have been familiar with gas transmission and gathering properties over a period from a minimum of six to approximately fifteen or twenty years.

Naturally we did not dig up and have an inventory made of the number of joints of pipe and the valves and other

fittings that are buried with the pipelines. However,
924 men associated with Mr. Hamilton have taken time studies on that line, a very substantial portion of the line, and these men actually saw the pipe going into the ground. We have pictures of it in our office as a part of these time studies, so that we are definitely informed that the pipe is there. In addition to that we had men making time studies of compressor stations where they observed the actual trenching of all of the underground pipe in connection with the stations, and saw the pipe as it was laid in these trenches.

We made a thorough check of the maps of the company and these maps, I must say, are very well kept up and very well made in the beginning. I feel that as a result of these checks of all these maps and of the field checks we made to verify the fact that all items of property shown on the maps actually existed, that the compilation of our inventory is a true and accurate record of all of the physical properties of these two companies with the exception of course of the gas leases. We left the gas leases out because we were advised that the gas leases would be handled by someone else, and were requested to pay no attention to their value. Our instructions were to confine our valuations to the properties other than gas leases owned by these two companies.

In my opinion this Exhibit 125, composed of two volumes, which was identified here and from which Mr. Eastman testified concerning some of the details, is a true and accurate inventory and listing of the property of these two companies as we were able to obtain. In my judgment it encompasses all of their properties except the leases.

This inventory naturally comprised volumes and volumes of data, and it was our task to summarize and tabulate that data in a form, necessary for pricing purposes, to fit the classification of accounts now in use by the companies. It was also necessary to tabulate the data in a form so that we would know what equipment came from the various manufacturers and the quantities of that equipment. The entire inventory was separated, in the case of the pipeline, by States, each State comprising a summation of all of the physical items in connection with the pipeline in that State.

The pipeline inventory was divided into States mainly for the purpose of pricing to reflect an accurate price for pipe in the several States. There are many factors that change the value or the reproduction cost of the pipe, and

of the materials, such as difference in freight rates, taxes that are applicable to material in certain States, difference in hauling rates, in labor rates, in insurance rates, such as workmen's compensation, public liability and other insurance that is applicable to labor. By so dividing the pipeline inventory we were able to reflect in each State the proper price for each foot of pipe and for all of the individual accessories of the pipeline.

In the case of compressor stations, that inventory naturally was taken for each station. However, if we deemed it a saving you might say that we could have grouped all of these compressor stations into one lot for pricing. But after investigation it was discovered that there would be no saving in this type of summary in the work that we had to do, as we would have had to average the prices
925 in the various locations and apply that average to all of the material which would result in a distorted price for any one particular item at any one station. So we priced all of the items at each of the ten compressor stations individually. This involved the work of compiling unit costs at ten different compressor stations for a large number of items in the stations that had the same manufacturer's quotations. In the case of pipelines, we priced separately for each of the six States, the pipe that was part of the system in each State.

While this tabulation was in progress, other men were engaged in the work of investigating all the original commitments of the constructing company, collecting over-all purchase vouchers or a large number of the purchase vouchers from the original completion date of the project up to the present time, in order to inform ourselves as to the kind of material or the description of the material that was in the property, and in order to familiarize ourselves with the manufacturer who actually furnished the equipment. After that investigation had been made, we tabulated this property by manufacturers who furnished the equipment or material, and prepared quotation letters for prices as of the valuation date on all of the equipment and materials involved in the system.

We sent these letters to the manufacturers in the various sections of the country. I would judge that we forwarded quotation letters to the extent of 250 to 300, and some of these letters varied from single pages up to quotations involving as many as ten or twenty pages, all containing different items of equipment that an individual manufac-

turer furnished. In these letters we asked the manufacturers or dealers to quote prices on the material that had gone into this pipeline. In asking for their quotations we asked them to furnish the net price that was available to this company under the consideration of the purchase of the quantity of items that were involved in the entire system, and reflecting all cash discounts and chain discounts that the company would obtain in the purchase of the large quantities that would be necessary in this construction. We received replies to these letters requesting quotations. All but one or two to whom requests for quotations were sent out answered, and those one or two in all probability were answered by other concerns who had since taken over the manufacturing concern that had gone out of business. We received back substantially every quotation that was requested.

I do not mean that we ourselves stated the price which was quoted. I mean that we received back our form on which we had listed the property with as complete a description as possible, and on which we asked them to quote us prices on the basis that I have already mentioned, first as of January 1, 1938 and then as of June 1, 1939. I mean by this that we requested these quotations at two different times in the course of our work for these companies. That was the only way possible to get current quotations on the various items of material and equipment. As we were required to bring our previous work down to date it was necessary, of course, to get quotations as of June 1, 1939 for the work as presented in Exhibit 125. In addition to the prices we got also the weights of all the equipment and materials. We needed the weights in order to calculate freight, hauling costs, and other similar things that involved the weight of the particular items.

926 Next we had to make up forms for the building up of unit costs for each and every item that appears in Exhibit 125. I would judge that there are in the neighborhood of from 12 to 20 thousand unit costs that we made up in the compilation of those volumes. Take the general item of pipeline material as an example. Our unit on pipe has always been the foot. Pipe prices are substantially always quoted by the foot or by the hundred feet, and it is a recognized unit in the industry. It also gives a clearer picture in the report as to the actual quantities that are involved in the system, the magnitude of the system. We added to

the cost of the pipe, the necessary freight, taxes that were applicable, hauling, and labor of installation.

In connection with our quotation letters we obtained the shipping point of all of the material, and an indication as to whether or not the quoted price was an f. o. b. point of shipment or f. o. b. destination price. We knew the destination of all of the material and we formulated a tabulation to obtain freight rates. These freight rates were obtained from established traffic bureaus. I believe our tabulation of freight rates involved in the neighborhood of 1500 tariffs for both carload and less than carload rates.

In the State of Oklahoma, as an example, it was necessary for us to obtain tariffs, both carload and less than carload, for all items of equipment in the Perryton compressor station. The physical property that comprised that station was purchased from locations as far east as the eastern seaboard and as far west as the western seaboard. We obtained the tariffs from the various sections of the country to the destination at, I say, Perryton, Texas, because the town of Perrton, Texas, is the closest town to that station, although it is located in the State of Oklahoma. It was also necessary for us to obtain tariffs on pipe for every destination where pipe was actually shipped to the company during the original construction of the line. In the State of Oklahoma this did not involve many locations, because the pipeline travels through what is known as the Oklahoma Panhandle and does not cover a substantial part of the State. But in that State, as well as every other state, we obtained tariffs, both carload and less than carload, on every point of shipment that was actually used during the original construction of the line. We went through the same detailed computations in arriving at the freight costs involved in the material which would have to be shipped to Texas, to Kansas, to Nebraska, to Iowa, and to Illinois. We have given effect to the differences in these freight costs in arriving at our unit costs. We have applied, with the same degree of detail, these costs to each of the 15 or 20 thousand units which are set out in this inventory.

In figuring these unit costs we used the labor rates that Mr. Eastman had secured, and applied them to our man-hour performance for each and every unit of installation that was compiled. When we received these quotations we very carefully scrutinized all of them, compared them with the data that we had available from purchase vouchers, reviewed them in the light of our own personal knowledge of

equipment extending through a period of some fifteen or twenty years and put them through every test that we knew to assure ourselves of their accuracy. In some cases it was necessary for us to further correspond with manufacturers in an attempt to justify in our own minds that the full information we had requested had been reflected in the
927 quotations. As a result of a few of these additional letters that had to be written, we obtained lower quotations on certain items of equipment. We justified in our minds before the use of any prices, the fact that that price was the correct price as of the particular date for which it was quoted. We gave careful consideration to all of these prices almost to an equal extent. As to the pipe prices, due to the fact that there was a tremendous quantity and a very large value involved, we were particularly careful in observing the quotations that were given us in the case of pipe. We recognized that due to the tremendous quantities involved in this system, and due to the condition of the market at the particular time, the prices of pipe called for a special investigation, and Mr. Hamilton conducted this investigation and will testify as to his findings. We used the figures given us by Mr. Hamilton as the cost that this company would have to pay if this project were to be constructed at this time. We received quotations from pipe and all other manufacturers, quoting prices as of January 1, 1938 and as of June 1, 1939. These letters, of course, were sent out at entirely different times. We knew the conditions of the market all the way through and we knew the quantities involved when we sent out these requests for quotations, and we made a study of prices available both before and after the quotations were received. We went through all purchase vouchers of the company for the years 1938 and 1939 and made the study in that form. Then, after the quotations were received, we thoroughly went over them, but decided that Mr. Hamilton should make a special investigation of pipe prices. Mr. Hamilton will explain just what he did and whether or not the prices he gave me were higher or lower than those set out in the quotations. I may say, however, that the prices we used were below the quotations in general. There may have been some exceptions. By that I mean that in general the ultimate net result was to use a lower gross pipe figure over the whole pipe consideration.

The taxes entering into the cost of this material are not the same character and type of taxes that Mr. Eastman was

discussing when he was going over the overheads and mentioned and discussed the items of taxes during construction. These are entirely different taxes, known as sales and use taxes on material and equipment. These taxes are paid at the time of the purchase or at the time of the use, as the case may be, of the material. There is no duplication whatever of the taxes which we have figured into these unit cost computations and those taxes that were under discussion by Mr. Eastman in his treatment of the subject of overhead costs.

The term "stringing cost" as applied to the construction of a pipeline is that cost involved in the unloading of the line from the cars of the railroad siding, hauling it out to the right-of-way, and stringing or distributing it along the right-of-way. Our costs for that item were determined from the actual man-hours used during the original construction of the line, taken from our pipeline time studies, with labor rates as of the present time applying to the man-hours, and the prices of equipment used in the hauling of the material. In the case of compressor stations we corresponded with hauling contractors who were actually engaged in the hauling of this material from the railroad siding to the compressor stations during the original construction, and were familiar with the quantities involved, the type of material involved, and the various terrain at the several locations where the material had to be hauled. We used quotations from these hauling contractors in the case of compressor station material and equipment.

928 This is not the type of hauling that we could go out and employ the local truck owners to perform. In the case of pipe we have joints that are 40 feet long and call for special equipment, and in the case of compressor stations equipment you have iron frames of these gas compressors that are so heavy that it calls for very special equipment in the hauling and handling of that material. The hauling of this type of heavy equipment and material is a specialized line of work, but there are hauling contractors equipped to do that work in the particular districts.

Taking into account all of these items after we had grouped or separated the different types of equipment by states, and by stations as I have testified, we applied the cost of the material at the factory, the freight, the hauling, the construction, the insurance, the sales and use taxes, and incidental costs going with labor such as compensation insurance and that type of cost as we found those charges

and costs to exist in the several states or at the several stations. Charges like insurance, workman's compensation and public liability insurance, like the other elements of cost, vary substantially in the several states. We added all of those items to which I have just referred into a unit cost which appears in Exhibit 125 as the unit cost of the particular item. In some cases there are many unit costs that were added together for pricing in Exhibit 125 for the reason that we found it necessary to condense a large number of small items that go to make up one particular unit. If we had gone into all the detail we would have doubled the size of that exhibit. However, I have all of the details of all of the items, and these details are available and we will make them available for the counsel and the engineers of the two commissions who are involved in this hearing.

In conjunction with Mr. Eastman and Mr. Stoddart, I had supervision of the compilation of this entire Exhibit 125. In general I had to do with all phases of all of the items listed on page 1. Our work is of such a nature that we must collaborate with one another at all times. The entire two volumes have been compiled in a form suggested by Mr. Hamilton and obtained through consultation or collaboration with my associates in this work, and the various details, of course, were passed on to men under my supervision. I took personal responsibility for presenting all of the general subdivisions listed on page 1 of this exhibit except those items listed as lands in fee, rights of way, gas wells, and those items of overhead beginning with engineering and superintendents, and so on, down to and including working capital. Mr. Eastman took responsibility especially for the figures in line 1, Account No. 1000, "Lands in Fee", Account No. 1002, "Rights of Way", and those overhead items and working capital down at the end of the list. Mr. Stoddart is especially responsible for the item listed under the caption "Gas Wells" and he will testify concerning that item. He was directed especially to devote attention to the matter of reproducing gas wells, or computing the cost of reproducing those wells. He also collaborated with us on other items.

By way of general explanation I would like to say that this exhibit consists of three parts. The first three pages are the grand summary of the individual companies and the sum of the two companies; Pages 4 to 64 are what we called a detailed summary and consist of a recapitulation

or a condensation of the detail which appears begin-
929 ning on page 66 and continuing on through to the final page of the second volume. There are several reasons for this condensation or recapitulation. First, it enables an individual to run through each and every item and find the total reproduction cost of the various items in each account in each State in total, and will afford a general over-all picture of the entire property. In addition to that the summary is made up in this form for the convenience of an application of depreciation. I mean the depreciation worked out by Mr. Biddison concerning which Mr. Eastman and Mr. Hamilton testified. Under this column of "Depreciation Deducted" the figures were obtained from Mr. Biddison, and the only work that was involved, as far as my direction was concerned, was just the mathematical subtraction of his figure to obtain our present value column on these detailed summary sheets. The figures for which I have assumed responsibility are those under the caption "Reproduction Cost New."

For convenience in following this report there has been an index placed just preceding sheet one, and the details of Account 1005, which is main lines, and which contain the figures on page 8, are shown on pages 109 to 132. On page 109 we find the beginning of the details of the main line in the State of Oklahoma, and continuing on to page 110 and 111, being totaled on page 111, to $1,292,094, which is the figure that appears on page 8. On page 109 we began with the listing of the detailed items included in the main line account in the State of Oklahoma. First we list the steel pipe and a description of that pipe as electric weld, plain end, 40-foot joints, 24-inch pipe with a weight of 86.908 pounds per foot. The detail indicates that in the State of Oklahoma there were 194,578 feet of pipe priced at a unit cost of 3.6463 dollars per foot. This same indication of the detail proceeds on through the right of way grading, the trenching both earth and rock, and back filling of all of the earth and rock; the welding of the line, the dresser couplings that are part of the line, the footage of enamel paint, the painting of the couplings, and on page 110 we list the two river crossings that are located in the State of Oklahoma, namely, the Beaver and Willow Creek river crossings. These two items show no amount for a unit cost because in the buildup of the price of a river crossing there are so many individual items involved, every river crossing being different from any other river crossing, the

complete detail of all of the items of physical property in connection with each river crossing would take up several pages.

All of the unit costs going into the total of $215,843, shown as the first total figure on page 110, are included in our working papers with a unit cost for each and every item that is a part of the river crossing. However, in this description we do give a general over-all description of what the crossing consists of, the size of the lines, the kind and length of the joints, the weight of the pipe per foot, and the actual footage of each different sized line in the crossing.

We then go on to highway and railroad crossings which to some extent are similar to river crossings, the detail of the unit costs consisting of many unit costs which are added together in our working papers. The main line gate valves that are a part of the line in the State of Oklahoma, the blow-off valves, valve boxes, the drips and drains that are located along the line, the fittings such as "T's" and nipples in bridges that are necessary in river crossings for the purpose of line walkers, and the other accessories such as sleeve houses and pipe racks, all have their individual cost listed and their quantities listed, and by the multi-
930 plication of the two we would get total figures which, added together, give us the total for the main line account in the State of Oklahoma of $1,292,094.

Questions by the Examiner.

Along the line of a pipeline they invariably have sleeves for the maintenance of a line. The sleeve house is a small house that houses a sleeve that may at some time during the operation of the line be necessary to place over the pipe to take care of any particular emergency that might come up. You might say, in a sense, it is a small storage house for the sleeves that are located on the line. They locate the sleeves on the line just as the railroads do spare rails.

On page 109, where we have the trenching and back filling, 24-inch, the figure stated is the average for the entire State of Oklahoma. It very truly reflects the cost in the State of Oklahoma. It is based on the actual present construction.

The highway crossings of 28-inch are not culverts. At all or practically all highway crossings the specifications of

the state, county, or other subdivision that might have charge of the highways require the pipeline companies to install casing over their regular pipe with vents coming out of the casing. That is why the pipe is a 28-inch. It circumscribes the 24-inch pipe, and at each end is welded through a coupling to the 24-inch line, and vent pipes come off of that casing from each side of the highway or railroad crossing. It is just to take care of anything that might happen to the pipe under the highway or railroad. If leaks should spring in the pipe underneath the highway the gas, instead of coming up through the ground into the highway where it might be set on fire by an automobile, is vented off to the side.

Direct Examination by Mr. Morgan Resumed.

This first line, 194,578 feet, is the quantity of footage of 24-inch pipe line that is found in the State of Oklahoma. We used the description electric weld plain end 40-foot joints of 24-inch pipeline, weight 86 and a fraction pounds per foot in the State of Oklahoma instead of describing the seamless pipe because that is the kind of pipe that is in the State of Oklahoma. In each state we have used the same kind of pipe that was actually used in the construction of this pipeline at each location where we have reproduced the cost.

The figure, 3.6463 dollars, represents the per foot cost of that pipeline. That amount reflects the cost per foot of that particular kind and size pipe, and includes not only the cost of the pipe at the mill but also the freight to the state, the use tax levied by the State of Oklahoma, which is applicable to all interstate purchases, and it includes the hauling, stringing, laying and lowering of the line into the trench. Ha ng built up all these items into one total, we multiplied the number of feet by the total cost per foot and arrived at this first total of $709,490. I am referring to the first unit cost on page 109. The unit cost is 3.6463 dollars per foot for the kind of pipe that was used in that state. That price is obtained from an f. o. b. mill quotation of 2.6551 dollars per foot for the pipe.

To that I have added freight in the amount of .6605 931 dollars per foot. That freight has been obtained by actually calculating the deliveries of the pipe in the entire State of Oklahoma to the many destinations of the State of Oklahoma and dividing the total number of dollars

of freight so obtained by the total footage of pipe in the state. It may not reflect any particular freight rate to any particular point in the State of Oklahoma. To that has been added the cost of a shop priming coat on the pipe. All this pipe, when purchased, was given a coat of shop primer to protect it against rust enroute to its destination.

This amount has been quoted to us by the manufacturer at .0225 dollars per foot. I then added a state use tax which is applicable in the State of Oklahoma not only to the material cost but to the freight necessary to get the material to its destination. This tax amounts to 2 per cent of the foregoing items, or .0668 dollars per foot. I then added the cost of unloading and stringing the pipe at .0938 dollars per foot, and the cost of laying and lowering the pipe at .1476 dollars per foot. All of these items total up to 3.6463 dollars per foot which is found as a unit cost on page 109.

The items included for unloading and stringing and those included for laying and lowering are obtained by application of the present-day labor rates existing in the State of Oklahoma to the time study man-hours which were developed from time studies taken on this pipeline, and include an allowance for all contractors' equipment that was used in connection with the stringing and laying and lowering of the pipe.

We developed the unit prices of a cubic yard of grading, or earth and rock moved in trenching, and the other different units that appear on this page, and the succeeding two pages, by the same detailed steps, insofar as those steps were applicable to those units, that we took in the case of a foot of pipe. Some of these unit costs, for instance the grading cost listed here, include no material other than the using of contractors' equipment. That is a labor performance with the machines and other equipment necessary to grade the tops of hills and the rights of way in general for the purpose of enabling the ditching machine to travel more uniformly along the right of way and to eliminate as far as possible the bends in the pipe.

Speaking of bends I would like to indicate that in this cost of laying and lowering there is an amount included for the necessary over-end and sag bends that must be made in the pipeline when it is going over a rolling country or through draws or ditches. We allowed for the same bends of one type or another that we find from the records were made in the pipe that was actually laid there by defend-

ants. We applied the use of our time study all the way through, and the man-hours for making bends were reflected in the time study together with the equipment that was used. We knew where to provide for a bend because the bends run along the system with the draws, the rolling country, and we have applied in the case of Oklahoma the man-hour study which applies to that particular section of the country. That study shows the work of that particular character. We did not count the bends in our inventory as they are properly reflected as a part of our time study man-hour performance. The performance of this bending is one of the things that was done by the men whose man-hours were computed in our time studies.

932 I have the detailed breakdown of each of these other items appearing as the unit cost in the third column shown on pages 109, 110, and 111 among our working papers which are and will be available to counsel and the engineers of the two commissions. These include also the details behind those two total costs on river crossings which are not indicated as a unit cost on page 110. All these working papers will be available to the engineers and counsel of the commissions at any time they desire. However, if it is not at the immediate time, I would like to have some notice as they comprise two or three immense boxes that would have to be put together and shipped. We have many jobs going on in various sections of the country and we would like to avail ourselves, at those jobs, of all of the information that we have that might assist in furthering any present or future work. These details can be shipped here (Washington) or made available at any location at any time we are notified.

We will go next to one of these compressor stations. As indicated by the index, the detailed summary covers pages 4 to 65, and that part covering the Texoma Natural Gas Company of which the Fritch compressor station is a part is on pages 40 to 64. The Fritch compressor station in the detailed summary begins on page 55, and the summary of the details continues over to page 56, listing all of the items in the Fritch compressor station and totaling the entire reproduction cost new to $2,258,071. All the classifications are not listed individually. For instance, you will find "Machine shop equipment" on page 56. Now that caption includes all of the machine shop equipment consisting of lathes, drill presses, hack saws, and such

other items of machine shop equipment. The list includes everything located at the Fritch Compressor Station which is properly chargeable to Account 1006 "Compressor Stations". There are other items at the Fritch station which are located in other accounts. The detail of the compressor station account for Texoma Natural Gas Company is on pages 758 to 795, which would be in Volume 2. On page 758 in Volume 2 we find the listed details of the auxiliary building in the Fritch compressor station, which is carried over to page 759. All the units on which we computed their cost on a unit basis are set forth in those pages beginning on page 758 and ending on page 795. I would like to add at this point the fact that in the listing of this detail in the valuation we have carried it all by the classification of accounts used by the company, recognizing that various classifications are in use by different companies. Due to the possibility of a new classification being necessary, we have attempted to list all of this detail in a form that could be readily converted to almost any classification of accounts. You will notice in the Fritch compressor station we have indicated each and every item of a structural nature, like buildings, in alphabetical arrangement first and then followed with items of equipment in an alphabetical arrangement.

We have worked out the number of units, whether stated in terms of weight, or dimension, or length, or quantity, whatever the manner of stating may be, and the unit costs of each of these units in this compressor station in the same detail and by the same method that we have worked out the details concerning the unit cost of pipe in Oklahoma. We used the different crews necessary for installation of the different items and applying taxes where they are applicable, and such labor rates as are applicable in the State of Texas. We do not use the same factors, of course, but we use the same method of applying such
933 factors as are applicable to each unit cost and break the unit costs down into the same character of detail which we mentioned when we were talking about the per foot cost of pipe, or the other unit costs in the State of Oklahoma in connection with the pipeline.

We went through the same procedure in each of the other compressor stations, at all of the meter and regular stations, at all warehouses and other locations along the line that had equipment belonging to the company, that was apart from the compressor station. Items like meter

stations and regulator stations, meter lines and regulator lines, are distributed through the exhibit at the locations or in the states where they actually occur in the system. These main line meter stations are the meter stations on the main line only and have nothing whatsoever to do with branch or lateral lines. In the State of Illinois we have a main line meter and regulator station that is a sales meter as it is the termination of the line where the final sale is made. In the State of Iowa we have other meter and regulator stations that are a part of lateral or branch lines from the main line. These appear on another account. These items do not occur on the main line which is the reason they are not listed in this account.

Going now, for the purpose of illustration, to the State of Illinois main line, I call attention to an item of $5,633,212. The detail of this amount, which is indicated on page 8 for main line in the State of Illinois, commences at page 125 and extends through to page 130, where the total of all of the detail on pages 125 to 130, inclusive, is tabulated. The pipe with which we deal at this point is exactly the same kind of pipe with which we were dealing in the State of Oklahoma except that this pipe has a bell on the end of it. This is just a sort of flare on the end of the pipe increasing the diameter, and was used for the purpose of facilitating welding and keeping the interior diameter of the pipe the same by use of a ring inside of the weld. We priced for the State of Illinois single bell end pipe instead of pricing it as of the same quality as that used in Oklahoma because that is the kind of pipe that was used by defendants in the State of Illinois. We are reproducing the cost of the same kind of pipe that is in the pipeline in Illinois and in all other states and other compressor station locations. It appears that in the State of Illinois the unit cost of pipe is 3.5734 dollars per foot as against 3.6463 dollars in the State of Oklahoma. There are elements involved in this buildup of the cost of 3.5734 dollars per foot that go to increase and decrease the cost. For example, this pipe that is known as single bell end pipe costs more per foot, or per ton, than the plain end pipe, so that the price of the pipe f. o. b. mill is higher than the pipe that was listed for the State of Oklahoma. The freight rate in the State of Illinois is lower than it is in the State of Oklahoma due to its being much closer to the mill. There is no sales or use tax applicable in the State of Illinois for this type of material. Other items

that go to vary this price are differences in labor costs, differences in the actual labor performance due to the different terrain, the different type of soil, and the factors encountered in laying and lowering and stringing the pipe. In other words, there are differences in the man-hours required to perform the work and differences in the labor rates applied to those man-hours. In each instance we gave effect to the actual cost of reproduction as we found the facts to be in the particular state where we are reproducing the pipe.

934 Each line of our summary beginning on page 8 and continuing through page 64, with the exception of page 39, is supported by detail in other portions of the exhibit which are readily found by account numbers and by the index shown on the page preceding page 1 in exactly the same manner as is the detail found in those items which I have discussed here by way of illustration.

The amounts set out for each account number indicated on page 1 are, in my judgment, a reasonable and accurate listing of the reproduction cost of the property included in the several accounts, based on prices as of June 1, 1939, and prevailing in the locations where the property is situated. I am now referring to these accounts 1004 to 1024, inclusive. The figures I was referring to were those set out in the column "Reproduction Cost New". In the second column on page 1, under the caption "Present Value", are set out the figures resulting from the subtraction of the depreciation figures furnished us by Mr. Biddison from those reproduction costs to which I was referring in the last two or three questions.

Cross-Examination by Mr. Booth.

I had nothing to do at all with the determination of the existing depreciation which was made by Mr. Biddison. The only work I had to do with the depreciation as listed in this report was the mathematical work of subtracting Mr. Biddison's depreciation from our reproduction cost new. That is true of the other members of our organization. They had nothing to do with the determination of the existing depreciation.

Cross-Examination by Mr. Slaff.

I will prepare a list of the cases in which I previously testified, with the dates on which I testified.

935 FRANK W. STODDART, a witness for the defendants, testified:

(September 1, 1939)

Direct Examination by Mr. Morgan.

My name is Frank W. Stoddart. I can't say definitely where I live because I am part of the traveling organization of Mr. Hamilton, and am usually on the road. My office, when I am at the office, is that of Mr. Hamilton in New York.

In 1925 I graduated from the College of Engineering at Iowa State College and received a bachelor of science degree in mechanical engineering. Immediately upon graduation in July of 1925 I was employed by the Cities Service Company and went to Denver, where I entered the employment of the Public Service Company of Colorado as a junior engineer in their training school. That was a training school designed by the Cities Service organization to train employees for future positions in their organization. I remained in the employment of Public Service Company of Colorado for approximately one and one-half years.

On the completion of my work there in December of 1926 I was assigned to a regular job with the Byerly organization. During the training period in Denver I was assigned to a special job in the fall of 1925 in the city of Fort Collins, Colorado, where I worked for the Colorado-Wyoming Gas Company. I was employed in the first place to do certain design work on a natural gas line which they contemplated laying from the Wellington Dome, near Fort Collins, to the cities of Fort Collins and Cheyenne, Wyoming. While there, I made all of the maps from the surveys of that line, designed various items going into the line such as gate fittings, drips, meter settings, buildings, and so forth, drew all of the plans for this, drew up bills of material for this work, and after work was commenced on the construction of the line was retained by that company as a welding inspector on the portion of the line running into Fort Collins.

My next assignment was at Joplin, Missouri in the employ of Empire District Electric Company with which I remained for a period from December, 1926 until about March, 1929. I was employed as a power sales engineer

in the lead and zinc mining district of southwestern Missouri, southeastern Kansas and northeastern Oklahoma.

In March, 1929 I was transferred to the New York office of Henry L. Doherty & Company, where I was employed in the rate and valuation department under F. C. Hamilton, with whom I have been associated ever since that date in rate and valuation work.

I am a member of the American Gas Association and at times I have represented Mr. H. D. Hancock, who is president of Gas Advisers, Incorporated, on rate committee work for that organization. Gas Advisers, Incorporated, is a mutual service company, similar to Electric Advisers, Incorporated.

936 Ever since my employment with Mr. Hamilton I have been engaged more or less in valuation work. I have prepared numerous valuations, in some cases working alone and in others with assistants. This work has been on oil marketing properties, which the company contemplated buying, and on natural gas pipeline systems. In 1931 and 1934 I assisted in the work of preparing a valuation of the Cities Service Gas Company. During quite a portion of that time I actually had supervision over crews in the field making inventories and crews in the office pricing that inventory and preparing it for presentation. I worked also on the property of Republic Light, Heat and Power Company, and Northwestern New York Gas Company, preparing a valuation of those properties for presentation to the Public Service Commission of New York. More recently I had active charge of work on the valuation of the Empire Pipeline Company, which is an oil pipeline having property in Kansas and Oklahoma and in the East Texas field, for presentation last year before the Interstate Commerce Commission.

In connection with valuation work, I have done some special work in the nature of pipe tests on pipe samples taken from pipelines in the Mid-Continental area. In other words, that testing was made for the determination of corrosion in pipelines and my work consisted not only of inspecting the pipe in the bell holes, but also of testing coupons, taken from sections of that line that had been removed, in the laboratories of the University of Kansas, and I have also made numerous burst tests on pipe in the shops of the Cities Service Gas Company. These were hydraulic burst tests.

I have never appeared as a witness in any proceeding before. I have had to do with the preparation of the valuation studies that are being presented here on the properties of defendants. I have been actively engaged in this work both in 1938 and in 1939, which is embodied in Exhibit 125.

I was not in Chicago during the entire time that the organization has been working on these studies because it so happened that the hearings before the Interstate Commerce Commission were being conducted during that time and I was here in Washington quite a bit of that time. I did spend the major portion of the time in Chicago last year and I was in Chicago during the entire time we spent on this work this year. I was assigned for special attention to the specific job of determining the reproduction cost new of the gas wells owned by Texoma Natural Gas Company.

On June 1, 1939 that company actually owned the physical property in 159 wells in the Panhandle field. I took or caused to be taken under my direction an inventory of all the physical equipment used in connection with each of those 159 wells. I sent men into the field to make an inventory of all the top fittings, that is the portion above the ground that could be seen, which I personally checked in the field. I have been in that field and have personally checked those notes, and I also personally made and directed the inventory in the office at Chicago from the records of the company of all that material, and of other equipment that goes into the hole that cannot be seen in the field. It is impossible, of course, to see anything below the surface of the ground in a gas well.

937 These wells are not all alike in the sense that they have exactly the same number of strings in the casing and the same length of casing strings. Each well is a problem of its own. In other words, the depth of the wells will vary, depending upon the depth of the sand, the sizes and lengths of the strings in the casing of the well, etc. So each one had to be figured out as an individual. We cannot look at a well and tell how deep it is.

We ascertain the facts concerning those features of the wells necessary for our information in the cost of reproducing them, which are not visible above ground such as the quantity of casing, the quantity of cement used, the depth of the well, and other things that may be hidden or invisible

about a gas well, from the records of the company. The company keeps a very accurate record of what goes in. They keep what is known as a well log; which describes the depth of the hole and the amount of material and kinds of material that went into that hole, and these records were available to me at the Chicago office. The facts utilized in calculating these reproduction costs as to those items which are not determinable from the surface were taken from the records of the company, including the well logs kept by the company. The strings of casing that I have assigned to each well are the actual strings of casing which are in those wells at the present time. If a well has three strings of casing I reproduced it with three strings of casing. If two or one, I reproduced it as having the exact number of strings that it actually has. The casing of all of Texoma's wells is cemented, and I ascertained from the records of the company the number of sacks of cement that was used in cementing the casing in the well and ascertained the cost of placing that cement at the bottom of the casing. I ascertained also the cost of the cement delivered at the well and the cost of putting it into the well. I drilled these wells to the exact depth to which they were actually drilled. In other words, we reproduced these wells exactly as we found them on June 1, 1939.

According to the index in the front of the exhibit, these wells will be found in the detailed summary in volume 1 of Texoma Natural Gas Company on pages 41 to 54, inclusive of the detailed summary. The first column in the detailed summary entitled "Reproduction Cost New" represents what I have calculated in the details as the reproduction cost new for each and every well owned by Texoma Natural Gas Company. They are listed by wells, and the amount of money found opposite each well is the reproduction cost new of that particular well. The amounts cannot be uniform due to the variation in the depth and size, the amount of casing in the well, etc. The first well listed is the L. A. Aebersold well, which may be found on page 568 of volume 2 of the exhibit. The first item on that page is headed "Casing". This is seamless casing, 8¼ inches in diameter and 32 pounds per foot. The quantity of this casing in the well is 2,487 feet, which I have priced at 1.8026 dollars per foot, making a total of $4,483. I arrived at the amount by multiplying the quantity by the unit cost. I took 2,487 feet as the quantity of casing because that is the amount of casing that I found from the

records to be in that well. I arrived at the unit cost of 1.8026 dollars in the following manner. That cost first contains a price of 1.4678 dollars per foot f.o.b. Lorraine, Ohio, for the casing material. That price was secured from the manufacturer of the casing as we sent him a
938 letter requesting quotations on that type of casing and this is the price quoted. That is an f.o.b. price from which we have subtracted 2%, the cash discount applicable to all casing. This reduces the price to 1.4384 dollars per foot. To this amount I have added freight from the mill to Texas in the amount of .2784 dollars per foot, which gives us a delivered cost of 1.7168 dollars per foot at the warehouse in Texas. All material going into the well passes through a warehouse, and the cost last stated is the cost to the warehouse. These companies generally buy quite a large quantity of material anticipating a certain number of wells to be drilled in the future, and put that material in the warehouse rather than on the lease, so it can be looked after and will not be stolen. To the cost in the warehouse I have added a warehouse charge amounting to .0858 dollars per foot, which, added to the delivered cost price, brings the total cost to 1.8026 dollars per foot, the unit cost I find on page 568 of this exhibit. That warehouse charge was worked on a percentage basis, based on all material going through the warehouse. That is partly a labor cost of tallying and handling charges, and of course there are certain fixed costs of the building for house material that have to be considered in that cost. In computing the reproduction cost of the item "Casing Clamp" I found from the records of the company that there was one set of casing clamps on this well. This is due to the fact that there is only one string of casing in the well so only one clamp was needed. I have priced this one set of 8¼ inch casing clamps at $15.27. I arrived at this price in the same manner that I arrived at the price of the casing in applying those factors that were applicable to it. In this item, and in many others in the exhibit, the totals are stated in terms of even dollars. I do not give effect to the 27¢ in the cost of the casing clamp, but treat that cost as $15. If the cents are less than the half, I throw them out, and if more than a half dollar I give it the dollar above. They will average out in the long run by totalling dollars. That is the uniform plan of organization in this exhibit. I arrived, of course, at the number of casing shoes and the number of lots of top fittings in the same manner that we

have done in all the others, that is, we used the actual number found in the particular well under consideration.

We come now to the item "Contract: Drilling—rotary tools—2,685 feet" at a unit cost of $3.25. The log of the well shows that when this well was drilled the contractor actually drilled it to a depth of 2,685 feet and was paid on that basis. All contracts for drilling are made on a per foot basis. We arrived at $3.25 per foot after sending out to several drilling contractors in that area requests for quotations on drilling, and that is the quotation we received from them for drilling in that particular area. I checked that with the contract price per foot which the company was paying currently as of June 1, 1939. The company is now engaged in drilling some wells and I found that the prices I have used here are identical with the drilling rates now being paid by the company. The contractor's contract calls for the drilling of a well to a specified depth and when that depth is reached his contract is completed and he is paid on the basis of the number of feet he has drilled. However, if after the drilling is completed certain cleaning out of the hole is necessary around the well which requires the contractor's time, he is paid for that additional time on a day basis. As a matter of fact, in the drilling of a gas well, it is often necessary for the contractor to be retained there with his tools until the well can actually be put on production after he has completed his work. I find occurrences like that in the records of the company. The amount I have used here I found by analyzing the drilling costs of a number of wells that have been drilled within the past six months or a year. They are not uniformly retained for one day. There is a
939 variation according to the records of the company. I found in certain cases that no day work was required of the contractor, and in other cases I found as many as five or six days required of the contractor. In order to reproduce this I could not tell what the hazards would be after drilling each and every well, so I have used an average figure which represents the average amount that the company would have to pay the contractor for extras. This one day is the average per diem payment which the company has paid on its wells as a whole, according to the records. I have used an average of one day for each well instead of undertaking to set out in each instance just the number of days that the contractor was held on each particular well. I did this because in reproducing these wells

it would be impossible for us to determine what hazards they would run into on each and every well. We do know those hazards exist, and in the past the company has paid this average amount for extra work. The $90 figure is the amount actually paid to the contractor as a part of his contract price for doing this work. This $90 covers 24 hours' work with his rig equipment and tools. That is contractual rate per day just like the drilling and the work that goes with the drilling is contracted on a per foot basis.

Questions by the Examiner.

I have applied that one day uniformly, but I think there are some wells where I have applied more than one day. I think there are some wells where I have applied more than one day. For instance, there are one or two wells in here that have been acidized, and I think one or two wells that were shot, and of course after acidizing or shooting a well, there is a certain amount of cleaning up to do, which the company contracts to the contractor, and whenever that exists I have determined how much extra day work is necessary for cleaning out the hole. For instance, the R. S. Coon well on page 598 shows nine days. In the second line below "Day Work" you will find an item of "Shooting Well." I determined from the records of the company that in shooting the well there would be an additional 8 days necessary for cleaning out the well after shooting it, in addition to the other cleaning out which would be covered by the one day. This 8-day special item of Day Work is very close to the actual time required as reflected by the records of the company. I did not arrive at it exactly in that way, however. When I asked the contractor for a quotation on shooting the well I also asked him in that letter to tell me how many days would be necessary to clean out after he had completed his work. This cleaning out would have to be done by the contractor and not by the shooter. I took this 8 days from his letter stating that so many days would be required to clean out the well after the shooting. I do not mean that the man who shoots the well would clean it out. There are two operations. One contractor would shoot the well and then the contractor who drilled the well originally, who is an entirely different contractor, would clean out the hole.

Direct Examination Resumed by Mr. Morgan.

If the shooting was done at the completion of the well, the original contractor would be kept there until the well could be shot and then he would go in and clean it out. This is a charge for keeping his equipment on the job and cleaning the well out after the shooting has been done. This 8 days is the time that we were advised by the man who did the shooting would be required for the contractor to clean out the well and condition it after he had administered his shot.

940 The reason I did not use the actual figures in this instance is due to the circumstance that some of the wells of Texoma were purchased at the time the company was organized and they do not have complete records, although we did receive from the companies that sold them the wells the log showing the depth of the wells, the amount of casing in the well, etc. We could not determine all the costs from those old records. In other words, I have tried to predicate my costs on wells being drilled currently. I applied this day work to all the wells, using an average figure. I averaged some of the wells which had not been cleaned out with some wells which had taken six or seven days to clean out and found that the average was one day for all wells. In other words, I was trying to arrive at an average cost that I could apply to some older wells that I had no records on.

These older wells on which we had no records as to such costs were wells that were drilled prior to being acquired by Texoma. We had no difficulty in finding records for the wells drilled by Texoma. I applied this one day of extra work in some cases to the wells Texoma itself had drilled because I took an average for all wells and in the long run it would average out.

"Cementing" I have included in the amount of $350 for each well. This is the actual amount paid by the company at the present time for cementing wells. In other words, a cementing job requires 125 sacks of cement which is put in the hole by the contractor, and the cost of putting it in the hole is the contract labor, so that is a uniform amount. I base that amount on what the company was paying currently as of June 1, 1939. The company is currently paying $350 for the material and labor of placing the cement in the well.

The next item, "Rig Expense", amounts to $1,099. This

rig expense includes two or three items mainly. It includes first, the cost of erecting the rig which is done by the contractor. The company actually furnishes the rig for drilling the well, but it does not attempt to erect it itself. It contracts the erecting of that rig. It is a steel rig and has to be put together on the site, so the company contracts for the erecting and dismantling of the rig. That is a fixed amount which I have determined from the records of the company amounting to $750, and to this amount for drilling a well with rotary tools I have added an amount of $349, which I have determined is the expense to the company for the rig which they own and furnish to the contractors. In other words, there is a certain amount of depreciation on that rig, certain fixed charges that have to be charged into each well, and this amount I have found to be $349. I have determined the amount and put it in here because it is properly chargeable to each well. I don't know just how they handle it, but I have determined the amount of expense that they are put to for drilling wells. It is not reflected in the job order for drilling the well.

In that connection I took into account the number of wells that would have to be drilled, and the period during which they would have to be drilled, in order to reproduce this property as a whole during the period of construction that we have used here in this study. I have assumed that all of these wells would have to be drilled in approximately one and one-half years, which was the construction period for the building of the entire system.

941 I determined that if all these wells were to be drilled in this one and one-half year period, they would have to have eleven rigs drilling at one time—continuously drilling throughout the period in order to drill all the wells in the specified time. I have just allocated to each one of the wells its proper proportion of the cost which would have to be incurred in connection with providing these rigs. These rigs are a very essential part of the process of getting these wells drilled.

You will find under "Contract—drilling" on page 570 that this well was drilled with cable tools whereas the wells on pages 568 and 569 were drilled with rotary tools. The fact that this was drilled with cable tools required additional expense in certain materials furnished by the company. In addition to the derrick unit they also furnished a bull wheel unit, a band wheel and walking beam unit, machinery supports, and so forth. There is additional in-

vestment involved in wells drilled by cable tools. Thus the cost corresponding to $750 and the $349, totaling $1,099 set out in the analysis shown on pages 568 and 569 must be changed to $1,272 in the case of the wells shown on page 570, in order to meet the actual cost of this cable tool type of rigging. This is the amount arrived at by allocating to each well its proportion of the total additional cost of drilling the number of wells that were actually drilled by cable tools. Those items shown on page 570, amounting to $351, $199 and so on down through the remainder of the column, are not dependent upon the depth of the well or the amount of casing in the well, but are miscellaneous expenses incurred in the drilling of the well and are generally uniform expenses for each well whether drilled by a rotary or by cable tools. I arrived at those figures by analyzing the actual costs of drilling the number of wells during the last 12 months, and have arrived at certain average costs for these items. In analyzing these records of the company I was able to break down into the component parts all of these items, and I found that they varied slightly from well to well, but in order to apply these present-day miscellaneous costs to the older wells, I had to take averages for all of these items, and these are averages which represent actual present-day miscellaneous costs for drilling wells. All these costs are actually incurred and paid and the company's record so reflect. I found that the total cost of reproducing the well referred to on page 568 is $17,008. By referring back to page 41 of the detailed summary under the column headed "Reproduction Cost New" we find that amount to be the first item in that column. On page 41 there is the figure $850 immediately to the right of the $17,008. That figure is in the column headed "Depreciation Deducted" and is the amount of money which was determined by Mr. Biddison and represents his figure for depreciation to be deducted from the reproduction cost new of this well. This leaves a net, after the subtraction of the depreciation from the reproduction cost new of $16,158.

These varying amounts set opposite the wells listed, beginning on page 41 and extending through to the middle of page 54, were arrived at in exactly the same manner as were the amounts $17,008 and $16,158 to which I have referred.

For the purpose of further illustrating the way we arrived at those figures, turn to page 569. We have some five

different kinds of casing listed in that well as against only one string of casing, all of the same kind, in the well set out on page 568. I have shown here the exact amount
942 of casing which the books of the company show to be in that well. In other words, I find that even in the case of rotary drilled wells, there is more casing in some wells than in others. In the case of cable tool wells there is sometimes more casing than in the rotary well. In each instance we reproduced the exact amount of casing that is found in the particular well.

From my study of the total number of wells, the way those wells were drilled and completed, the way they have been equipped, and the condition in which I have found them equipped as of June 1, 1939, and in the light of my investigation and that of our organization as to the material prices, labor costs, and other elements which we have figured in the unit costs applied to the material in those wells, it is my judgment that the figures set out in detail from page 568 to the middle of 726 represent the reasonable and actual cost of reproducing those wells if they were to be drilled beginning as of June 1, 1939.

These costs are carried back into our detailed summary beginning on page 41 and continuing through succeeding pages, in the column headed "Reproduction Cost New," and these figures set out in the third column under the caption "Present Value" represent in my judgment the reasonable cost of reproducing these wells new as of the time we have just mentioned, less the depreciation as determined by Mr. Biddison. The figures shown in the third column under the caption "Present Value" on page 41 and succeeding pages to the middle of page 54, represent the amount left after deducting the existing depreciation as determined by Mr. Biddison from the reasonable cost of reproducing those wells as of June 1, 1939. This represents the present value calculated by deducting the depreciation as determined by Mr. Biddison from our reproduction cost new.

These depreciation figures are not my figures. I merely recorded them on the sheet, subtracted them from the reproduction cost new, and arrived at the figure in the third column. I think the subtraction is correct.

Questions by the Examiner.

Under the terms of the drilling contracts I read, they provide for a fixed sum per foot, with a provision for an additional sum if the driller runs into difficulties. The additional sum is an amount for the time necessary for him to work on cleaning up the job. If it takes him 1 day, it is so much money, and if it takes him 2 days, it is so much money. It is all stated in the contract at so much money per 8-hour shift.

Direct Examination Resumed by Mr. Morgan.

I have all the work sheets showing the details used in the preparation of the figures submitted in Exhibit 125. These work sheets and supporting data will be available to counsel and engineers of the two commissions.

943 I can't say whether the provision for paying the contractor for extra work is part of the contract for drilling the well, but it is paid on a per day basis. The trouble which usually causes the detention of the contractor after the actual drilling is completed is usually due to something that gets into the drilled part of the well such as the caving in or bridging of the formation after the well has been drilled, and the footage obligation completed.

Cross-Examination by Mr. Slaff.

The reason that in some places we use $4 per foot as the unit cost for drilling while in others we use $3.25 per foot is due to the fact that the drilling rates vary from county to county. Drilling contractors have established prices for various parts of the field, due partly to the fact that water is hard to find in some places and there they charge more per foot, and so on. It is an actual contract price and is the amount that is actually paid by the company in various parts of the field. Texoma is actually paying $4 per foot right now for the drilling of some of their wells. In Moore County the wells are drilled deeper than in Gray County, and the depth of the well tends to slow up the rate of the drilling under some circumstances. It takes longer to drill out the last part of a deep well, and they charge more for it. There are three unit costs per foot used in the exhibit —$3.25, $3.50 and $4. In Hutchinson County we find that it is $3.50.

Questions by the Examiner.

We furnished the contractor with information showing the depth of the well and the amount of casing in the well, and told him in which county the well was to be drilled, and he quoted his bid price on the basis of that information. He would bid the same way on a well if we were actually going to drill it today, on the basis of that limited amount of information. He is very familiar with the field, and by knowing in which county the well is to be drilled, he is familiar with the depth of the sand; he is actually drilling wells there today; and can readily make a bid on drilling a well in that area.

944 F. C. HAMILTON, recalled by defendants, testified:

(September 1, 1939.)

Direct Examination by Mr. Morgan.

When my organization was arriving at the cost of various materials and equipment which would be required to reproduce this pipeline, I personally took the responsibility of determining the proper cost to be applied to the pipe that would be required. I did this for the simple reason that I have had an opportunity to familiarize myself with purchases of pipe for a great many years. Beginning back in 1918, I made an original cost study of the Republic Light, Heat & Power Company property as it is now constituted in and around Buffalo, New York. That property contained some of the earliest gas lines that were laid. In our New York office we have some paper weights that were made from the lead pipe that led to a flare in Fredonia, New York, at the time of Mr. Lafayette's celebration. Some of that pipe we have in the museum in New York, and there also came out of that district some wooden pipe made by boring holes through logs which were longitudinally fastened together with what we guess to have been Civil War army blankets covered with tar and joined on each end to the wood with steel straps. That particular line was laid by the Bloomfield and Rochester Natural Gas Company. It was laid in 1870. I cannot recall the name of that old company that laid the lead pipe because, of course, we were not familiar with it. In that original cost study, of course,

we found a large portion of cast iron pipe with two types of joints, oakum and tar or yarn and lead joints. Later we found, as time went on, more wrought iron pipe. Then there was developed finally the steel pipe in the form of lapweld pipe. We have available in our office those records up to 1918 from that original study as to what those various types of pipe cost. I am eliminating the lead and wood pipe, of course.

That original cost study was presented to the New York State Commission, to the Bureau of Capitalization, for the purpose of the authorization of the securities on the consolidation of several companies which are now represented by the Republic Light, Heat & Power Company.

About two years ago we were requested to bring up to date from 1918 the cost of the property which had been constructed there since that time, and reclassify all of it under the new classification of accounts put out by the New York Public Service Commission. Yesterday, at Albany, two of my men presented the entries for approval on that work, so we have the history of that company from the beginning, back in 1868, on down to date.

At the present time, in anticipation of the order of the Federal Power Commission putting in the new classification of accounts for natural gas pipelines, I have had men working for a period of nine months on the Cities Service Gas Company's records and the records of the predecessor companies that now constitute the Cities Service Gas Company. The tentative classification of accounts has been put out and has not been made final, as far as I know, for natural gas pipelines, but is expected to be made effective as of January 1 of next year. That work on the Cities Service Gas Company's records has developed costs of pipe beginning in 1904, which was when their first line 945 was laid by the Kansas Natural Gas Company. That has all been available to me. That first line laid by the Kansas Natural Gas Company was 16-inch plain and lapweld, 20-foot length pipe weighing 43.168 pounds per foot. The price of that pipe f.o.b. Pittsburgh at that time was $58.20. I just cite that to show where some of the information that I have been able to acquire comes from.

In addition to that, I have been engaged in the valuation of large gas pipeline and gas distribution companies for many years, and on the occasion of each valuation I have had to secure quotations for pipe. Naturally, I checked those quotations each time against purchases of pipe which

have been made by the company in periods prior to our determination of the cost of reproduction.

During a long period, from 1925, I was on the executive committee of Henry L. Doherty & Company, to whom was submitted the operating budgets of the subsidiaries of Cities Service for each year. Those operating budgets included their construction programs and necessarily included their estimates of cost of construction. Because of my department's work and familiarity with prices, questions as to the adequacy of the estimate of such items of construction as pipelines were submitted to me. From about 1924, I have had a man in my office who has done very little else except keep a continuous index of prices of the various items that enter into the construction of natural gas pipelines and of electric and artificial gas utilities. I, of course, made available to him for his assistance all of the information which was gathered in the way of quotations, and by checks on costs that had been paid by operating companies where we were making valuations. Also, I have had to do, in a responsible way, with the approval of construction projects on which, of course, estimates of the cost of construction based on quotations had been submitted.

Because of the fact that so much of the cost of defendants was dependent upon the price of the pipe itself, roughly some $14,000,000, I felt that it was necessary, in collaboration with Mr. Eastman and Mr. Willard, to spend considerable time on the accurate determination of what should be the proper cost of pipe. That could easily be determined if the amount were small, because you would pay what is shown by the current standard discount sheet plus an extra 10 per cent discount for quantities, but when you run into such enormous quantities as are shown in this valuation of one particular size, for instance of the 24-inch—there is in this system about 214,000 tons,—when the quotations came in, the quotations on the 24-inch showed that they had given all of the discounts in their quotation that appeared on the standard discount sheet, and that they had taken off 10, 10 and 5 per cent, approximately, in addition to the regular discount sheets that you might expect with reasonable orders. When it came to the smaller quantities in the other sizes, they had not quoted nearly so desirable a price. They had quoted more in line with the prices that would be expected to be given for the quantities of those particular sizes that were shown in our requests. In our

requests for quotations we had asked for a quotation on the quantity that was shown in the inventory. For instance, they quoted prices on the 16 and 12-inch pipe as if those were the only pipe purchases involved. This was also true of most of the smaller sizes of pipe. They had not done that on the 16-inch because there was a very considerable portion of that, but on most of the smaller sizes that is what they had done. I felt, and I still feel, that a purchasing agent who has in his hands an order for such a large quantity of one size could hammer the pipe manufacturers into giving him the same quantity discounts
946 on those quantities of smaller pipe, notwithstanding there were not sufficient quantities of that smaller pipe to justify such a discount.

Those quotations on the large size pipe were $62.35 a ton f. o. b. Gary for electric weld and $60 a ton f. o. b. Lorraine for the seamless 24-inch pipe. By interpolation we found what seemed to be the additional deductions that they had given over prices that were available to the public and to pipelines in general, and then we applied the same additional discounts to all of the rest of the pipe on the system.

They had done one more thing in this situation on these bids. The standard discount sheets apply to lap weld pipe. There is, and there has been for many years, a fixed addition per ton, after the standard discount of $2 for electric weld and $3 a ton for seamless. In these quotations they omitted those additions from the standard discount sheets and then still applied the discounts which I have listed. That is generally what we did and as a result that has lowered the cost of the 24-inch pipe in this system below what the company paid for it when they did have this tremendous order in their hands by about $1,725,000. The 24-inch pipe, in other words, is in here, so far as the pipe itself is concerned, at $1,725,000 below what the company actually paid for it. I was familiar with this company generally at its inception. I knew about the preliminary work that was done on this, and I do know that we all felt when they made their original purchases of such a large quantity that they had reached what then was an all-time low for the purchase price.

Question by the Examiner.

The manufacturers' discounts were all based on lapweld pipe. The base price is always $200 a ton. That does not change. They issue changed discounts that apply to dif-

ferent sizes, and always apply the discounts to lapweld pipe. We will say that the discount for a particular size is 60 per cent, then your price would be $80 a ton for lapweld. If you want to order electric weld instead of that then the price would become $82, and if you order seamless the price will become $83. In other words, those additions are not subject to the discounts; they are added after the discounts are taken off. But in this particular situation they apparently not only gave the additional discounts to the companies but left off the additions for seamless and electric weld that had hitherto been put in.

Direct Examination by Mr. Morgan Resumed.

The net result, covering all of the pipe, as between the prices quoted and the prices we used here is a very considerable reduction below the original cost. I computed it only on the 24-inch pipe, because I had that tonnage available, but in the prices per ton the reduction on the other sizes below the quotations which we received, and below the prices that were paid originally, ran all the way from $2.30 per ton to as high as $30.40 a ton, according to the particular size and the particular purchase. As to the comparison between the prices quoted in response to our letters and the prices we used in Exhibit 125, the prices on the 24-inch are identically what they quoted us because they were quoting on that large quantity. The prices on all other sizes were less than they quoted us. I have examined that exhibit and I have been in contact with the work both this year and last year so that I am thoroughly familiar with what is in that volume. It was prepared under my direction.

947 Taking into account my experience in valuation work, my knowledge of the costs involved of the materials utilized in the construction of this pipeline, and the other costs incident to the assembling of its physical parts into a pipeline system, and in the light of the investigations that have been made concerning time hours, labor costs, and all of the other elements that have been mentioned here by me and other witnesses, it is my judgment that the amounts stated in this exhibit and summarized on page 1 of this exhibit, constitute in their aggregate the reasonable amount that would be required to reconstruct or reproduce this pipeline, if constructed as of June 1, 1939. (Objection by Commission counsel.) In my judgment it represents the

lowest price at which the property could be reconstructed at that date, with a reasonable construction period allowed. That construction period I have assumed to be the same period that was covered by the construction of the pipeline in the beginning. That study includes all of the physical properties of the two pipeline companies with the exception of the leaseholds.

Assuming the existing depreciation to be as stated in the figures furnished to me and my organization by Mr. Biddison, the figures in the second column set out on page 1 under the caption "Present Value" represent the lowest cost at which these pipeline properties could be reproduced after deducting Mr. Biddison's figures for depreciation. I have already stated that the figures set out in this exhibit have to do with the reproduction cost new less existing depreciation furnished by Mr. Biddison of the inert physical property. By the term "inert physical property" I mean that it was a collection of the material and equipment into a pipeline, so far as the physical property alone was concerned, and that it included no cost for seasoning the line, preliminary operations after the completion, and no cost for attaching business and making it an operating organization or building up a force to operate.

By "preliminary operations after the completion" I mean such operations as are necessary in the process of seasoning and tuning the plant up after it has been completed. There are always incidental costs involved in these early operations.

In addition to the value of the inert physical property, as I have defined that term, there is, as to this particular system, a going concern value.

By "going concern value" I mean a value to be assigned to the property over and above the cost of its physical property because of the fact that it has made the necessary expenditures and sacrifices to get a business attached, and that it has this business attached and has built up the income and is a going concern. Those costs, of course, come after the construction of the pipeline and are something that create an item of value. In other words, this pipeline without customers and without business is something entirely different from this pipeline that does have customers attached and is doing business, with its organization seasoned, familiar with their jobs, and with the resulting low operating costs that you get from that kind of organization.

At the request of defendants I have undertaken to an-

alyze and determine from the records of the companies what the costs and the sacrifices of building the load and making this business a going business or going concern have amounted to in terms of dollars.

948 First I had, as did some of my older men, a quite intimate knowledge of the original cost of this property and the things that had to be done to get its business established. I considered it as an integrated project because the two defendants are interdependent.

In the first place, these costs for attaching business on this property are lower than could be secured by any pipeline with which I am familiar. The reason for it is this: It is a single pipeline from a single field to a market that has a potential use of many times the capacity of the pipeline, so that the cost of securing a sufficient load to fill the pipeline would be less than would be the cost of securing a load for a pipeline that was built to supply all of the ultimate needs of the whole district.

One of the reasons for this lower cost is this: In any town where the sales of gas are quite universal in all homes for cooking, water heating and house heating as they are in towns in Kansas, Missouri and Oklahoma, the average investment of the average domestic customer in equipment, by actual inventories which I have made, runs to roughly $135 per customer. When I say that I am giving you the average of the numbers of poorer homes and the smaller number of large homes. It is an average for domestic customers based on inventories of all of the equipment in all of the houses in town, and applies to domestic customers only.

When we run a pipeline to a town which has not had natural gas we start out endeavoring to sell gas to supplant other services which those customers have had, maybe coal, maybe oil, in some cases wood. Assuming that our gas rate is comparative, we still are up against the reluctance of the customer to throw away his investment in whatever equipment he now has and which he has bought for the purpose of utilizing the fuel which he did use prior to natural gas. In Chicago, because they were not building a pipeline of the size to supply all of the customers with all of their needs, they could get customers who were less reluctant. In other words, their time of attaching load would be less than it would have been were they building a pipeline to get all of the load that is there available.

I have made a study of what those items of developing

and attaching business would cost in the case of this pipeline. I might add again that it was not built for the ultimate load, but it comes as near being a 100 per cent load factor as any pipeline with which I am familiar. You could not secure such a desirable load factor, if you were trying to supply all of the needs for heat of all of the customers in Chicago, or of any other town that I know of.

The business of any natural gas system fluctuates from month to month because of climatic variations which affect the sales to the domestic customers, and because of the variations of the seasonal needs of the industry. We have adopted, for the basis of these computations, the sales in the year 1936 of $14,537,985, for the year 1937 of $15,546,451, and for the year 1938 of $14,456,899, and have averaged those, arriving at an average figure of $14,847,112. Those are the only three full years during which the pipeline has operated since it was fully loaded. So I have used as a basis the average of those three years. Now during that period the capacity of the pipeline was increased by the installation of additional compressor station capacity. The nominally rated capacity prior to that in-
949 crease was 175 million cubic feet a day. Today it is 210 million cubic feet a day. Both figures have been exceeded on particular days due to packing of the lines. I have therefore taken 175 over 210 as a fraction, and reduced by that ratio the $14,847,112 which constituted the average revenue of three years, with the result that I got $12,372,593 as the amount of sales that would have represented the ultimate capacity of this system prior to the increase in its capacity. In other words, if the line had been loaded from the beginning and had a capacity of 175 million, the revenue which could have been expected on the same load factor that has obtained during these three years would have amounted instead of $14,847,112 to the sum of $12,372,593.

Using this $12,372,593 as a basis of the revenue representing the full load capacity as it existed prior to 1936, I have made a tabulation to indicate the average non-productive capacity in each of the preceding years. In the year 1932 the revenue was $5,854,567, which represented 47.3 per cent of the productive capacity. In 1933 the revenue was $6,254,177, which represented 50.5 per cent of the productive capacity. In 1934, the gross revenue was $9,485,366, or 76.7 per cent of the productive capacity. In the year 1935 the revenue was $12,036,535, or 97.3 per cent

of the productive capacity. In these various years, subtracting the per cent of load that they have from the load which they could expect, and which they did get, we have in 1932 non-productive capacity of 52.7 per cent, in 1933 of 49.5 per cent, in 1934 of 23.3 per cent, and in 1935 of 2.7 per cent.

It must be appreciated that in the construction of a pipeline system such as this it is economical to build a pipeline for the ultimate capacity for which it is designed at the time you first install it. I might give you this example, that in the first year of operation they had nearly 50 per cent of their ultimate capacity in the line. You cannot have piece-meal construction in the pipeline, because it would have taken an 18-inch line to have carried 50 per cent of the capacity of a 24-inch line, and the 18-inch line for rights of way, and many other items, would have cost the same as the 24-inch line. The pipe and labor costs of installation and trenching would constitute far more than 50 per cent of the cost of the same items for the 24-inch line, so that the economy lies in installing the 24-inch line. You cannot make a piece-meal construction of pipeline capacity with economy.

The participants in this project received mortgage bonds bearing an interest rate of 6 per cent for the majority portion of the funds which they advanced for construction purposes. They knew, as a matter of course, when they advanced these funds that a certain number of years would be necessary before the project could acquire a business that would allow the payment of their interest, or the payment of dividends on stock. Anybody familiar with pipeline operation knows that. They also knew that it would be necessary to spend a very large sum of money on sales promotion work, both directly and in the way of contributions to distribution systems for the promotion work of those systems, if they were rapidly to build up the load. The earnings of the system from 1932 to 1935, inclusive, were not sufficient to meet the bond interest, and the companies were forced to borrow to meet ordinary cash requirements. No dividends were paid. I have taken the interest expense which represents the interest on the bonds together with the interest on the Gulf note which was given for the acquisition of some of the property that is now owned by the company. Those interest payments for 1932 were
950 $3,666,350. For 1933 they were $3,625,079, in 1934 they were $3,598,329, and in 1935 they were $3,474,732. To

the interest for each of these years I have applied the percentage that was indicated by the non-productive capacity computed from the revenues, with the result that 52.7 per cent of the 1932 interest expense amounted to $1,932,166; 49.5 per cent of the 1933 expense amounted to $1,794,414; 23.3 per cent of the 1934 expense amounted to $838,411; and 2.7 per cent of the 1935 expense amounted to $93,818. The total of these four items is $4,658,809, and represents the rental on money which was invested in idle capacity during the period of the acquisition of the business that they now enjoy.

Bonds, of course, would not have been salable at the inception of this property, and I felt that in applying the interest rate of six per cent that was paid for all of this money I have applied a rate less than would be required to raise money for a new project similar to this. I have taken those ad valorem taxes that apply to the property itself, not including income taxes and items of that kind, and have applied them in exactly the same way. The taxes paid in 1932 were $301,766; in 1933 they were $301,629; in 1934 they were $270,558, and in 1935 they were $289,193. Applying these same percentages that I used in the previous calculations, I have determined the amount of taxes paid through that period on property that was non-productive. These percentages result in $159,031 for 1932, $149,306 for 1933, $63,040 for 1934, and $7,808 for 1935, a total of $379,185.

A determination of the amount of depreciation existing in this system as of June 1, 1939, has been made by Mr. Biddison. He determined the depreciation existing on that date on the system as amounting to $2,866,758. For the purpose of this computation we have made the assumption that this depreciation occurred at a uniform rate throughout the 8-year period since construction. On this basis the annual amount of depreciation would be $358,345. By that I mean the depreciation that has occurred, which has not been replaced by maintenance or otherwise. Applying to this amount the ratio of the increase in capacity of the system due to installation of additional compressors I reduced that by taking 175/210 of it, arriving at a result of $298,621.

Taking for 1932, 52.7 per cent of this, for 1933, 49.5 per cent of it, for 1934, 23.3 per cent of it, and for 1935, 2.7 per cent of it, I arrived at the depreciation represented in

the system today attributable as having occurred on the non-productive capacity during those four years, and it amounts to $382,832.

Certain expenses on a natural gas pipeline are fixed and do not vary in proportion to the quantity of gas handled. In other words, certain officers' salaries do not go up and down with the gas handled, and neither do taxes and other items. Certain other expenses do vary almost directly in proportion to the quantity of gas handled, and naturally during the development period these expenses are much lower than in subsequent years when the full capacity of the line is being utilized. Without making detailed analyses, we have considered that the general and administrative expenses, pipeline expenses and telephone expenses are fixed and that a certain portion of these expenses are properly attributable to the system's non-productive capacity.

951 I have, therefore, taken those fixed operating expenses which were in 1932, $1,127,807; in 1933, $881,430; in 1934, $810,684, and in 1935, $882,028. Applying these same percentages for non-productive capacity to these amounts I have a total for the four years of $1,243,366. By pipeline expense I mean that pipeline expense as contained in the Commission's Provisional System of Accounts as opposed to compressor station expense.

Prior to any construction, in fact beginning in July, 1939, various market surveys were conducted by participants in the project, and these surveys were available to the companies at the time the actual construction of the project was begun. No part of the expenditures for these surveys is included in the tabulation of direct expenditures made for the purpose of attaching business.

During the years since the completion of the project the companies have made the following direct expenditures for the sole purpose of attaching the business which they now have. In the year 1932 they spent $86,105; in the year 1933, $219,149; in the year 1934, $889,060, and in 1935, $373,058, or a total of $1,567,372 for building the business up to full load. I will add here, for the purpose of comparison, the expenditures by the same department in 1936, 1937 and 1938, which amount to $16,371, $16,115 and $17,788, respectively. In other words, the expenses were cut down to a very minimum as soon as the load was acquired.

Included in the total of these expenditures which I have listed were contributions to the Chicago District Pipeline Company amounting to $187,131 in the year 1933 and $705,-

065 in the year 1934, which were made for the sole purpose of developing the domestic and house-heating business of those utilities serving the Chicago territory. In 1933 $749, in 1934 $160,243, and in 1935 $353,783, or a total for the three years of $514,755 was contributed to utilities operating outside the Chicago area for the purpose of developing their business.

It must be borne in mind that while these expenditures were being made by the pipeline company there were other large expenditures being made by the distributing companies for the purpose of attaching business, with the result that the other expenditures tended to help attach the business to the pipeline, but included here are only the expenses of the pipeline company itself.

I have summarized these items as follows: Rental on the money invested in the non-productive capacity, $4,658,809; taxes paid on non-productive capacity, $379,185; depreciation on non-productive capacity, $382,832; fixed operating expenses due to non-productive capacity, $1,243,366; direct expenditures for attaching business, $1,567,372, or a total of $8,231,564. These costs that I have shown do not include all of the costs of attaching business, and such costs as are here included are low because of the very favorable situation of this pipeline as compared with a pipeline designed and built to supply all of the heating needs of a particular town. There has been omitted from these calculations any costs incident to the seasoning of the plant, which costs always follow the beginning of service on any system of this nature, and neither has there been included at any place any costs for the assembling and training of the operating personnel.

Based on these actual out-of-pocket costs incurred in order to provide, because it was economical to do so,
952 facilities for the handling of gas in advance of obtaining the load of gas to be handled, and taking into account my knowledge of the history of this company and of the progress it has made and the volume of its business, the properties of these companies possess, in addition to the value of the inert or bare physical properties, a value of at least $8,500,000 in the nature of going concern value.

Cross-Examination by Mr. Slaff.

In referring to pipeline expense I was referring to the company's own accounts which it considers pipeline expense and which was taken from their books. It would not include pipeline maintenance expense.

Cross-Examination by Mr. Booth.

I was directed by the defendants in this case to prepare a reproduction cost appraisal of the property of defendants, that is the physical property of the defendants, exclusive of leases, and to prepare this appraisal based on the prices prevailing on June 1, 1939. I was directed by the defendants to deduct from this reproduction cost new the amount of existing depreciation which had been determined by Mr. Biddison. I do not sponsor in any way the amount of existing depreciation determined by Mr. Biddison. I have no connection with it other than to be responsible for the mathematics of deducting it from the cost of reproduction. In addition to that I, myself, prepared this study to which I have just testified, as to the going concern value of the property. That is all I was directed to do upon behalf of the company in presenting this case. I also prepared an appraisal based on 1938 prices but was not asked to present it in this particular case. All there is here is the 1939 appraisal.

Further Cross-Examination by Mr. Slaff.

I have a list of the cases in which I have testified but unfortunately the only dates I have are the dates that I was on the case from the beginning to the end. I cannot give you the dates at which I testified and will not be able to do that until I get to the New York office. I will have somebody get that up for me and get the exact dates.

Further Cross-Examination by Mr. Booth.

While I did not undertake to value the leases, as I have already stated, Mr. Eastman, in connection with his study of preliminary operations of the company, included the delay rentals paid on the leaseholds during the period of construction. That is the only way in which these leases enter into our study. We did, of course, include the wells, as explained by Mr. Stoddart.

953 (Document entitled "Texoma Natural Gas Company, Gas Well Details, Well Groups Nos. 1 to 12, Inclusive," marked Exhibit No. 118 for identification.

Document entitled "Errata Sheets for Exhibit No. 122," marked Exhibit No. 124 for identification.

Document entitled "Rate Reductions Effected by the Introduction of Natural Gas in the Communities Served by Natural Gas Pipeline Company of America," marked Exhibit No. 126 for identification.

EXHIBITS NOS. 118, 124 and 126 offered in evidence. EXHIBIT NO. 118 received in evidence without objection.)

954 P. McDONALD BIDDISON, recalled by defendants, testified:

Direct Examination by Mr. Hedrick.

(September 5, 1939)

At the time I testified in this case before, which was at Chicago, on August 3, 1939, I went into my educational qualifications and experience over the time I have been engaged in business since leaving school. I will add to that statement the experience I have had in making estimates concerning the existing depreciation in the various properties ordinarily owned by natural gas pipeline companies.

During the war and shortly after the close of the World War I had occasion to acquire pipe for construction purposes for gasoline plants in the State of West Virginia, and during that period I bought a considerable amount of used pipe because new pipe was almost unobtainable. I inspected a great deal of this class of material at that time to determine the purposes for which it was usable. Prior to that time, during my connection with the Ohio Fuel Supply Company and its associated companies, I had numerous occasions to examine oil well and gas well casings, to determine its suitability for re-use. About 1913 or 1914 I was required to examine and pass upon the condition for re-use of a considerable amount of natural gas lines which had been acquired, or were being acquired by the Ohio Fuel Supply Company in the south central Ohio gas field areas. I was required to determine how much of this pipe was suitable for re-use and for what purposes it could be re-used, and what portions of it would have to be junked. About

1923 I made inspections of natural gas pipelines and distribution lines in the vicinity of Camden and Eldorado, Arkansas, and Monroe and Bastrop, Louisiana, for the purpose of fixing the price upon properties for purchase by my then employers. In 1923 I made purchases of a large amount of used oil line and gas line pipe for the purpose of relaying in Louisiana. This material was acquired in Indiana and Illinois in sizes from 4-inch up to and including 12-inch. On this pipe I determined the purposes for which it was suitable to be used, directed the amount of rejections, and the amount of repair work on it, and put it in condition for use.

In 1936 I made the determination of the suitability for re-use of about 70 miles of 12-inch pipe lifted by the Lone Star Gas Company, determined the rejections, the repairs necessary to put the usable pipe in condition for re-use, and in that connection I made a rather detailed determination of the distribution of pitting on that pipe. Each joint of that 70 miles of pipe was inspected from end to end by men under my directions for the determination of the amount of pitting and the distribution of pitting.

In 1928, and again in 1936, I think it was, I made an inspection of the distribution properties at Fort Worth, Texas, of the Fort Worth branch plant of the Lone Star Gas Company, for determination of the condition of that property in a valuation. I have made similar determinations on the condition of pipe in distribution of plants for Galveston, Waco, El Paso, Wichita Falls, Sherman, Denton and Greenville, all in the State of Texas, and for a group of 33 smaller towns in Texas of the Community Natural Gas Company, and for a group of 26 smaller towns in Oklahoma for the Community Natural Gas Company.

955 In 1931 I made a determination of the condition of the transmission lines and compressor stations of the Cities Service Gas Company in connection with a valuation.

In 1932 I made a determination of the condition of the production and transmission lines and the general property of the Lone Star Gas Company located in Texas and Oklahoma in connection with a valuation. Again in 1933 I made a similar determination. I made a determination of condition of the production and transmission lines and general property of the Oklahoma Natural Gas Company in the State of Oklahoma in 1937.

I made a determination of the condition of the oil pipelines of the Empire Pipeline Company in 1937, in connec-

tion with a valuation made by others for presentation before the Interstate Commerce Commission.

I made a determination of the condition of the production and transmission lines and general property of the Arkansas-Louisiana Gas Company located in Louisiana, Texas and Arkansas in 1935 in connection with a valuation in which I was participating.

I made an inspection of the transmission lines of the Southern Natural Gas Corporation in the State of Louisiana in 1933, in connection with some taxation suits that were pending.

I made an inspection for the determination of the condition of the property of the Albuquerque Natural Gas Company in the State of New Mexico in 1935, in connection with a valuation as of the same period, for presentation in a case involving the application of the New Mexico statutes in regard to making common carriers of natural gas lines.

In 1936, I made an inspection to determine the condition of certain oil gathering pipelines in the East Texas oil field in connection with the valuation used for the consolidation of properties.

I made an inspection of the distribution and transmission lines of the Sapulpa Gas Company properties in and near Sapulpa, Oklahoma, in connection with the valuation which I was preparing. I have made inspections of the distribution properties of the Arkansas-Louisiana Gas Company for the determination of their condition in connection with valuations in Texarkana, Eldorado, Conway, Pope, and some other minor communities on that system, all in the State of Arkansas.

Those inspections to which I have referred cover property of the same general character as the property of defendants.

The published bulletin to which I referred in my testimony of August 3, concerning gasoline plants, was written by George A. Burrell and George C. Overhold, both at that time associated with the Bureau of Mines, and myself as co-author. It was a U. S. Bureau of Mines bulletin and was No. 120 and entitled "The Extraction of Gasoline from Natural Gas by Absorption Processes". This same bulletin was presented substantially as a joint paper by the same authors before the Natural Gas Association of America at Pittsburgh, about the spring of 1917.

956 I was requested by the defendants here to make an inspection of their properties to determine their physi-

cal condition. I made two inspections: One in March, 1938 and one in May, 1939. I have prepared a report of my findings in the form of an exhibit for presentation in this case.

(At this point counsel handed to the reporter a document entitled "Natural Gas Pipeline Company of America and Texoma Natural Gas Company—Valuation of Property—Deduction for Depreciation as of June 1, 1939, Witness P. McDonald Biddison". At the direction of the Examiner, the document was marked Exhibit No. 127 for identification.)

These findings are set forth in Exhibit 127 for identification. In general the contents of this exhibit are, first, a letter of transmittal and explanation, and following that on page 1 is a title page, on page 2 an index, beginning on page 4 is a tabulation of the condition of the respective items of property, the reproduction cost new of those classifications as determined by Mr. F. C. Hamilton in Exhibit No. 125, the amount of depreciation to be deducted from the reproduction costs new by virtue of the condition in which the property is found, and a column of present value figures which represent the remaining amounts after deduction from reproduction costs new of the amount of depreciation.

On pages 4 to 38 are included the property accounts and values as described for Natural Gas Pipeline Company of America. On pages 40 to 64, inclusive, are shown the values as described for the property classifications of Texoma Natural Gas Company. There is a relationship, so far as page numbering is concerned, between Exhibit No. 127 and Exhibit No. 125. For example, it will be found on page 4 of this Exhibit No. 127 that the items shown are the identical items shown on page 4 of Exhibit No. 125. That example illustrates generally the relationship between the arrangement in the two exhibits. That is true down to and including page 64 of Exhibit No. 127. The detailed data in Exhibit 125, pages 66 and following, provide the underlying details for weighing out the observations which I made and applying the percent condition factors. Having applied those percent condition factors to those details in pages 66 and following of Exhibit No. 125, I have produced the condition figures shown in summary form in Exhibit No. 127.

I do not mean that I applied the percent condition to all the details of the units shown on pages 66 and following in Exhibit 125, but I did apply it to such details as it was necessary to use, and the detail in Exhibit 125, pages 66

and following through to the end, are the details of the same property shown in my Exhibit No. 127.

In 1938 I began by an inspection of the equipment in the Chicago office; then went to Amarillo and made an inspection first of the equipment of Texoma Natural Gas Company in the field, the gathering system, wells, well measuring stations, and of the Fritch gasoline plant and compressor station, and followed that through on the transmission line of Texoma Natural Gas Company up to its connection with the property of Natural Gas Pipeline Company of America.

The inspection began in the Chicago office on March
957 24 and was completed at Joliet on April 4, 1938. In the 1939 inspection I started at the Amarillo end of the line on May 16, and went across the system in the same fashion, completing the inspection in the Chicago office on May 29. During the 1938 inspection, I was accompanied throughout the trip by Mr. Mark Burlingame, one of the engineers for defendants. In each division we were also accompanied by the division superintendent or the division foreman, or both. In the 1939 inspection, I was accompanied throughout the trip by Mr. Mark Burlingame, and by Mr. Johaningsmeyer, an engineer for the Federal Power Commission. We were also accompanied in the districts by the respective district superintendent or foreman, or both.

Referring to Exhibit No. 127, and in particular to pages 4 to 6, covering Account No. 1000 "Lands in fee", and pages 7 and 8, covering Account No. 1002, "Rights of Way", it will be noted that no depreciation is shown. That is due to the circumstance that these accounts cover fee lands and rights-of-way, respectively and that character of property is not depreciable.

Before starting out on each of the two inspection trips to which I have referred, I instructed the management to cause holes to be dug at approximately 5-mile intervals over the entire pipeline system allocated on the gathering system as between the various sizes generally in proportion to the mileage of the sizes. These holes were opened and were so dug that there would be six feet of pipe exposed, four feet of the exposed pipe was scraped clean of all protective coating. The bitumastic enamel was removed and the wrapper was removed so that four feet of exposed pipe could be inspected. Two feet of protective coating was allowed to remain in place so that an examination of the condition of the coating itself could be made. The holes

were so dug that clearance was allowed on both sides, and underneath the pipe, so that the pipe could be examined clear around in circumference, and so that the protective coating could be examined for two feet at the end of the bare four-foot section of pipe. For the 1938 inspection there were 42 holes on the gathering system of Texoma, 15 on Texoma's main line and 168 on the pipeline of Natural Gas Pipeline Company, a total of 225 holes.

In the 1939 inspection, on my instructions holes of identical size and character were opened, except that the holes were spaced at approximately 10-mile intervals and staggered with respect to the holes dug for the 1938 inspection.

(At this point counsel handed the reporter a map entitled "Natural Gas Pipeline Company of America, Texoma Natural Gas Company Bell Holes Dug For Inspection of Pipe—Total System". At the direction of the Examiner, the document was marked Exhibit No. 128 for identification.)

In the 1939 inspection, there were 15 holes dug on Texoma's gathering system, 7 on Texoma's main line, and 83 on the lines of the Natural Gas Pipeline Company of America.

Exhibit No. 128 is a map showing the location of the inspections made of pipelines for the inspections both in 1938 and 1939. At the lefthand end of this map and divided off by vertical lines from the main portion of the map, is an enlarged map section showing the pipelines of Texoma Natural Gas Company. At a point in the southwest portion and near the southwest corner of Hutchinson County may be noted the name "Fritch". This is at a junction of a red horizontal and a red vertical line, and that junction point is at the location of the Fritch Compressor Station and Fritch Gasoline Plant. From that point there ex-
958 tends to the right a red line nearly horizontal running out into Gray County. I am referring to the heavy red line and not to the smaller, lighter red line. This line represents the gathering system bringing gas from Gray and Carson Counties into the Fritch Gasoline and Fritch Compressor Stations. Running to the left of this same central point and extending out into Moore County is another heavy red line connected up to lighter red lines, which represents the gathering system of Texoma Natural Gas Company, bringing gas from Moore County. In other words, there are two separate gathering systems, one going to Moore County and one going to Gray and Carson Coun-

ties. The smaller red lines are branch lines off of the larger gathering trunk lines, and the smallest ones are connected to wells which are represented by stars.

The numbers in the orange circles represent numbers assigned to inspections made on this gathering system in the 1938 inspection. From the orange circles the blue lines leading down to the red lines lead to the locations on the pipelines at which the respective inspections were made. The green triangles and the lines leading from them up to the red lines indicate the location of inspections on this system made in the 1939 inspections. I may also add an explanation on this section of the map, that from the Fritch Compressor Station and Gasoline Plant running to the northeast there is shown a heavy red line with a multiple crossing of the Canadian River. This is the main transmission line of Texoma Natural Gas Company. And the red line in the right-hand section of the map from Fritch in a generally northeasterly direction to the Nebraska-Iowa line is the main pipeline of Texoma Natural Gas Company and Natural Gas Pipeline Company of America. I might point out that at the point where this pipeline crosses the Missouri River the map has been bent; that is, the line was changed so as to get this map all on one narrow strip, and that the true direction of the line east of the Missouri River would be properly delineated on this map if the map were cut in two at the Missouri River and two sides of the Missouri River brought into conjunction, to show the right angle at which the line turns at the Missouri River Crossing.

I will now take as an example of what I did when I made those inspections in 1938 and 1939, one of the green triangles leading up to either the main gathering line or the smaller gathering lines of Texoma Natural Gas Company. We will take No. 5X which represents an inspection made in 1939. This inspection was on a 24-inch Gray County gathering line, on what is called the Gray County main line in the gathering system. The line was welded. The coating on this particular section was asphaltic. The amount of covering over the pipe—this is not the depth of the trench but the distance from the normal ground level to the top of the pipe—was 60 inches. The inspection was made at station 1170 plus 74. This station to which I refer is the survey station and is the company's field designation for a particular point in the survey. It is the engineering record of distances along the line. The location was 50 feet north

of drip number C-24 W in Section 38, Block 4, I & G N Survey, Carson County, Texas. The soil was loam with caliche streaks. The coating was good, but light surface rust and light etching on top of the pipe could be seen.

By "light etching" I mean the effect of corrosion which could just barely be detected by looking at it, appearing as though it might be etching with the application of acid, or something of that sort, a very light surface attack. There were no pits and I assigned to the pipe the condition of 99 percent, and to the protective coating a condition of 70 percent.

959. We will take 25X. That point is on the line of Natural Gas Pipeline Company of America. The line is 24 inches, is a combination welded and coupled line. The protective coating was bitumastic enamel. The cover over the line was 67 inches. The location was at mile 31, station 5,088 plus 17. "Mile 31" means that it is the 31st consecutive section of land through which the line has passed. It does not mean necessarily the 31st mile. The survey station shows that it is not that. This location is in Section 23, Township 4, North, Range 22, East, Beaver County, Oklahoma. The soil was clay to caliche sand. The coating was poor from flux and soil indented with small rust stains. Light etching on pipe and very small pits. I measured the depth of these pits and found that in the first one-foot section the pit depth was 10 mills. A mill is 10/1000 of an inch. There were 4 feet of bare pipe exposed. This 4 feet was divided into four one-foot sections. Where pits were found, the procedure was to measure the pits on each of those one-foot sections and the depth of the deepest pit was recorded for the particular one-foot section. In measuring the depth of these pits I used a Moorlane pit depth gauge, an instrument designed particularly for measuring the depth of pits in pipe.

I have given a great deal of study to the relationship of the depth of pits and extent of pitting to the condition and usability of pipe. The value of pipe is affected, of course by the depth of pits and by the relation of those depths to wall thickness. It is also affected by the diameter of those pits, and by the relationship of that diameter to the circumference of the pipe. It is also affected by the distribution and frequency of pitting and by the character of the pitting, or the size of the eroded areas, if any. I know of no way to relate all those factors to produce a mathematical expression by which you may determine the condition of

pipe. It is a matter of judgment in making the detailed examination as to what the condition of the pipe is. In my case, the condition of the pipe was based upon my many years' experience in that kind of work. Without that experience in such work my opinion would not be worth anything on the value of pipe that has been in service.

From my observations in the State of Oklahoma on the property of Natural Gas Pipeline Company of America I determined a condition for the pipe which applies to the fittings and the installation of 98 percent, for the protective coating 62½ per cent, for the river crossings and line walkers bridges 90 percent, and for sleeve houses and pipe racks 95 percent. Those conditions, applied to the reproduction cost new values determined by Mr. Hamilton, produce a present value figure of $1,215,481, which is 94.07 percent of the reproduction cost new figure of $1,292,094.

(Objection by counsel for the two Commissions to the qualifications of the witness to testify as to present value overruled.)

On pages 8 and 54 of Exhibit 127, in Account No. 1005, "Main Lines," for the two companies, I divided the line into States: Texas, Oklahoma, Kansas, Nebraska, and so forth. That was done because I thought a more balanced weighing out of the observations could be obtained by taking the states as units for grouping the observations and applying the results to the reproduction costs figures, than by simply averaging out the figures and applying them to the property as a whole. It was convenient to do that because the valuation itself had the property grouped by states.

960 In determining the condition percent of the main lines, I took into consideration the findings made from the examination of the pipeline at the various points shown on Exhibit 128. Going back to my examination of the hole at No. 25 X, shown on Exhibit 128, I may add that I found the pits on the four one-foot sections to arrange in depth as follows: Ten mills, ten mills, six mills and ten mills. I assigned to the pipe a condition of 97 percent and to the protecting coating a condition of 30 percent.

In my examination of the pipeline of both of these companies in 1938 and 1939, I made observations as to the depth of cover over the top of the pipe in each of the states. On the Texoma Natural Gas Company property, the average cover determined from my observations is as follows: On the 24-inch main line, 52 inches; on the 24-inch gathering

line, 51 inches; on the 16-inch gathering line, 60 inches; on the 10-inch gathering line, 44 inches; on the 8-inch gathering line, 34 inches; on the 6-inch gathering line, 27 inches; on the 4-inch gathering line, 30 inches. On the 24-inch main line of Natural Gas Pipeline Company of America, I found the average cover in the State of Oklahoma, 56 inches; in Kansas, 56 inches; in Nebraska, 57 inches; in Iowa, 62 inches; and in Illinois, 63 inches. The over-all average is 59.6 inches. On lines other than 24-inch, such as lateral and river approach lines of sizes other than 24-inch main lines, I found the cover in the State of Nebraska to be 57 inches; in Iowa, 44 inches; and in Illinois, 47 inches.

The meter station mentioned on page 8 of Exhibit 27, under Kansas, is the tie-over connection between the systems of Natural Gas Pipeline Company of America and Panhandle Eastern Pipeline Company. Most of the equipment at that station is above ground and visible, and can be readily seen. I looked it over and made notations as to its condition. The property actually showed no deterioration except the quality of the paint materials on there. The allowance there is to take care of deterioration that would not be visible. Shown on page 8 are a meter station and a regulator station in Illinois. The condition of these stations is shown at 97 percent. Those are the stations at Joliet, Illinois. I examined those two plants in detail and made notations on location as to the condition of the property at those plants.

As shown on page 8, I found the average condition of the main lines of Natural Gas Pipeline Company to be 95.66 percent. In the second column, the reproduction cost new, as determined by Mr. Hamilton, was $26,558,660. Applying my percentage of depreciation, the deduction was $1,152,908, leaving a reproduction cost new, less depreciation, designated under the column "Present Value," of $25,405,752. The same explanation is true as to Account No. 1005 of Texoma shown on page 54 of the same exhibit. The items were arrived at in the same fashion.

The meter station, designated under the word "Oklahoma" on page 54, is the State line measuring station at the point where the gas delivered by Texoma Natural Gas Company to Natural Gas Pipeline Company of America is measured.

Turning to pages 9 to 23, inclusive, which show Account No. 1006, "Compressor Stations of Natural Gas Pipeline

Company of America" and to pages 55 and 56, which
961 show Account No. 1006, "Compressor Station of Texoma Natural Gas Company," I made an examination and inspection of all these compressor stations. In general, I first went into the office of each individual compressor stations. I noted the condition of the office furniture and equipment, made notations on specific items. I would then proceed to the auxiliary building, the building which houses the electric power generating equipment and the water pumping equipment, and the machine shop, the electric lighting equipment, storage battery equipment.

Station No. 2, sometimes referred to as the Perryton Compressor Station and sometimes as the Gray Compressor Station, is the second station on the system, Fritch being No. 1. The facts as to this station are set out beginning on page 9. The first line under Compressor Station No. 2 is Auxiliary Building, on which I found the condition percent to be 92.98. That percent condition is the composite result of the application of the observed condition to the reproduction cost estimate of various components of the building. As a result of my inspection of this building, I have assigned to the superstructure a condition of 95 percent; to the foundations, a condition of 95 percent; to the floors a condition of 90 percent; to the curbs a condition of 95 percent; to the stairways a condition of 95 percent; to the down-spouts and gutters, a condition of 95 percent; to sumps, a condition of 95 percent; to pipe trenches, a condition of 95 percent; to lighting, to heating, and to plumbing, a condition of 90 percent; to partitions, a condition of 95 percent. Applying those conditions to the reproduction cost figures for the specific items mentioned, I obtained a present value of $11,281, which is 92.98 percent of the reproduction cost new of $12,144. This is the same thing as a deduction for depreciation of $853.

Cross-Examination Interposed by Mr. Slaff.

I didn't assign percentages to every individual item making up the equipment classification under the terms of lighting or heating. I assigned to lighting separately a condition of 90 percent. I grouped the heating and applied to the heating group 90 percent. I grouped the plumbing, and applied to the plumbing a condition of 90 percent. I grouped the partitions and applied to them a condition of 95 percent. There are some instances, in the case of large

structures, where I made specific notations further breaking down information as to superstructures, but generally the example I have given applies to the major structures. Now for small structures I did not weigh out the values in that fashion, but assigned to the individual structure an over-all condition based upon the observations. (Objections by counsel for the two Commissions to the designation of "reproduction cost new less depreciation" as "present value" overruled.)

Direct Examination Resumed by Mr. Hedrick.

Column 1 in Exhibit 127 is my work. Column 2 in this exhibit is as shown, the reproduction cost new to which Mr. Hamilton and his associates have testified in this case in connection with the presentation of Exhibit No. 125. The amount of the depreciation deducted as shown in the third column is my determination, and that determination is made by applying to reproduction cost new values, of which Mr. Hamilton's Exhibit 125, the condition which I determined by my investigations. The application of those conditions to the reproduction cost new figures produced the figures in the right-hand or fourth column under the heading "Present Value." Throughout the entire ex-
962 hibit, the last three columns are the same as are shown on pages bearing the same numbers in Exhibit 125, with the exception of the title pages and the index pages. (Motion by counsel for the two Commissioners to strike testimony with respect to present value denied.)

After I made my examination of the auxiliary building referred to on page 9, my general procedure was to proceed from the auxiliary building to the main building. The main building is the largest structure at these stations, and it houses the gas engine driven compressors, that constitute the main equipment of the plants. At this building I have inspected the condition of the superstructure, the engines and their attached compressors, and the condition of the floors, the lighting systems, of the ventilating systems, if there were such; and made notations as to the condition of the various items of equipment in that structure. Then I would generally proceed to look over the cooling tower and the yard piping of the station, and generally from there to the warehouse. Most of these stations have located on the premises a warehouse for the use of the pipeline opera-

tions and maintenance crews. I would then inspect that structure and the equipment that was housed in it. Then I would generally proceed to inspect the condition of the dwelling houses, the cottages, the boarding house, and so forth, and would during the course of my examination make an inspection of the sidewalks and roads and fences and the shrubbery and lawns. I went through that general procedure at each station of the Natural Gas Pipeline Company of America and at the Fritch Station of Texoma Natural Gas Company.

At the compressor stations I made separate notations as to the individual structures and separate notations as to the condition of each of the major items of equipment. There were some minor items of equipment, of course, at each plant, on which I did not make individual notations. Little things like that in the final analysis have practically no effect upon the determination of values.

The percent condition shown in column 1 on pages 9 to 23, for Natural Gas Pipeline Company of America, and 55 and 56, for Texoma Natural Gas Company, represents my judgment of the condition percent of those various items listed. I would like to explain with reference to that volumn of conditions that the items of condition which are even percents are in general individual observations of the particular item, while those which are fractional percentages are the result of weighing out a number of observations against the reproduction cost new figures given in detail in Mr. Hamilton's Exhibit No. 125. That is not always the case, but that is the general rule as to the conditions. Where I had a composite figure such as for the main building on page 9, of 94.83 percent, and in other places where it shows odd percentage, I arrived at that composite percent in the same general manner as I testified in connection with the auxiliary building, which is shown in the first line on that page. In general, the ones where it shows an even percent are separate items where there was no composite involved. That applies all the way through Exhibit 127.

Passing to page 24, which shows Account No. 1008, the telephone system of the defendant Pipeline Company and on page 60, which shows the same account, representing the telephone system of Texoma, the term "pole lines" means the outdoor line equipment consisting of poles, guy wires, anchors, cross-arms, braces, brackets, insulators, wires, tie wires, in general the telephone lines running cross country,

as distinguished from the ringing and connecting equip-
963 ment and phones at specific locations such as compressor stations and warehouses. Equipment of the kind last mentioned is designated by the term "stations" as distinguished from "pole lines."

At each one of the stations, compressor stations, and at each one of the warehouses where the equipment was located, I saw the equipment and I made notations as to its general condition. In going over the pipelines of the two companies, I had opportunity at very frequent intervals to see the pole lines, because those pole lines in general are fairly close to the pipelines. On the property of the Texoma Natural Gas Company in the Amarillo field, the telephone lines in general are along the pipe-line right-of-way, but on the system of the Natural Gas Pipeline Company of America, the telephone lines are in general along the roadways, and they may be seen and inspected in driving from one of these test hole locations to another at numerous places. So that I had an opportunity to observe the condition of telephone line equipment just about as frequently as I observed the condition of pipelines.

Mr. Johningsmeyer was generally, but not always, in a separate car during these inspections, and whether the pole line was identified to him throughout the distance there, I could not say. I know it was in some instances, but in how many I don't know.

Cross-Examination Interposed by Mr. Slaff.

In some instances, I stopped and made individual notations of individual poles and in other instances I just looked at them as I drove along. My working papers will not disclose what I did in any specific instance. They will merely disclose that I made an observation. They will show an observed condition as applied to pole lines for each location at which I made an observation. They will not show whether that observation was one which I made in transit or one which I made standing still. My work sheets will show that this observation at or near a certain pipeline survey station number, or between certain pipeline survey station numbers was made. It will show only that at some point between those two locations I inspected the telephone lines. It will not give the pole number. It will include a percent condition for the location at which I saw the pole line. My working papers will not include the percentage

condition for the entire pole line between the two locations indicated on them. I saw the pole line at a specific point and the extent of that specific point may have been a couple of poles or it may have been a mile or two if I rode along. My records will not disclose. They will show that I observed that line and made a notation as to its condition. If I drove from bell hole No. 125 to hole 126 and saw the telephone line in between there, I would make a notation as to the condition of that line as I saw it between those two pipeline inspection locations. That is an over-all percentage for that two miles, or five miles, or whatever it may be. In a number of cases my observations were made as I drove along without stopping.

Direct Examination Resumed by Mr. Hedrick.

I also stopped at a great number of telephone poles and made detailed inspection of them. Whenever I saw anything of some unusual character, I stopped and made an inspection. I examined the butts of poles in a number of cases minutely to see what shape the creosoting was in and how much protection still remained.

Cross-Examination Interposed by Mr. Slaff.

964 I put down my observation as to the over-all condition which I judged that line to be in, but I did not make specific notations in my work sheets to the effect that I had stopped at a specific pole and observed conditions of the pole, of the creosoting, of the butts, the crossarms and other specific notations.

Direct Examination Resumed by Mr. Hedrick.

In addition to actual viewing or inspecting the property myself, I took into consideration other matters in arriving at the percent condition. At each station I made an examination of the operating, maintenance and repair records. These records disclose the micrometer measurements of the various engine parts made to the annual overhaul periods and disclosed repairs made to various portions of the equipment. I examined those records and took those records into consideration in fixing the condition of the equipment at the compressor stations.

Turning to pages 25 to 29, inclusive, and page 61 of Exhibit 127, which refer to Account No. 1009 "Meters and Regulators", I visited each of the stations listed and inspected the equipment in service at those stations. As to the reserve equipment, I have not seen all of those items, but the equipment itself I have seen, and the condition assigned to the equipment in reserve is based upon the condition in which I found the equipment in service. The term "in reserve", as used here, means exchange equipment held for the purpose of changing the equipment when repairs and adjustments are required. I find almost invariably the condition percent of the meters and regulators in service is more than that in reserve, because for the equipment in reserve I have allowed for the known fact that some of it is in reserve for repair and adjustment. Consequently, those that are not in service on account of repair and adjustment, the percent condition would be lower than those in service.

Cross-Examination Interposed by Mr. Slaff.

Where the percentages are the same for equipment in service as in reserve, that merely means that I did not make the extra allowances on that particular equipment. It simply means that I did not make an additional allowance on that equipment of adjustment. It is not necessarily true that all this equipment is out for adjustment and repair. That is true in some cases. In most cases I make such an allowance simply to allow for the possibility or necessity of repairs and adjustment on equipment that was out of service. Where I did not make the allowance it was simply because the equipment was out.

Direct Examination Resumed by Mr. Hedrick.

As I have stated, I saw all of the equipment that was in service. On that I have allowed 95 percent and the percentages which are shown in the first column. Where the equipment was in reserve on account of repairs, I generally made an allowance for the fact that it was in reserve because repairs and adjustments were in process or contemplated or probably necessary. I have not made a determination with respect to each of those items of reserve equipment, as to whether repairs were then neces-

sary or not, but I have in general made an allowance for equipment in reserve because, in general, the equipment in reserve is out for the reason that once in a while this equipment has got to be repaired and adjusted, and some of this equipment which is in reserve is in the process of repair and adjustment.

965 I have been at the location of the structures shown for Account 1010 and shown at pages 30 to 34 and 62 and 63 of my Exhibit 127. I made notations as to the condition in which I found those structures. Many of them are meter and regulator station buildings. Some as on page 32 at the top are for other purposes. This Red Oak warehouse is a group of structures, one housing materials and equipment for the pipeline forces for repair and maintenance and the other housing equipment for the compressor station repair and maintenance work. I inspected those structures and assigned to each structure a condition based upon those observations. With respect to the structures in Account 1010 for Texoma shown on page 62 and continuing on page 63, the first item is "Meter Stations, Amarillo Field". I inspected a large number of such meter stations, both in 1938 and 1939, and determined their average condition was 95 percent. The other structures shown, the Dumas and Kingsmill warehouses, and the meter station on the main line in Oklahoma, I inspected and made notations at the site as to the condition of the items shown, except that there may be some minor items on which I did not make notations at the location.

Cross-Examination Interposed by Mr. Slaff.

With respect to meter stations of Texoma shown on page 62 as being in 95 percent condition, I examined many of the meter stations in the field and arrived at a 95 percent condition and applied that to all the meter stations in the account. My work sheets show percentages for each individual meter station that I examined. I went out and looked at the first meter station which would be shown on page 862 of Exhibit 125 and having examined it I put down a certain percent for the condition of that meter station, if I saw that particular station. Then I went to the next one and looked at it and put down another percentage, whatever it was, for that one, and so on as to all those stations that I examined.

I added up the percentages and then used the over-all figure of 95 as a round figure to represent the condition of all meter station structures in the Amarillo field. The figure that I actually came to, instead of the figure I used, was 95.2 percent. I applied 95 percent to the figure of $27,090 and arrived at the present value figure of $25,736, as shown on page 62 of Exhibit No. 127. That results in a figure of $1,354 for depreciation to be deducted, and that figure of $1,354 for depreciation to be deducted is the figure for that item of property which I furnished to Mr. Hamilton for his use. The 95.2 percent condition to which I referred a moment ago is a numerical average of my observations on meter station structures which I observed. We will assume that for the first meter station which I examined, I arrived at 90 percent condition, for the next one 97 percent, the next one 93 percent, the next one 92 percent and so on. When I was all through I added up all those percentages and divided the total by the number of meter stations I had examined.

Direct Examination Resumed by Mr. Hedrick.

The 95 percent is the average for all that I examined, I then took that average percentage and applied it to the reproduction cost new of the total. If I had applied the percentage that I found for each of the items in question to the cost of each item as determined by Mr. Hamilton and got a present value figure for each and then added all such figures together it would be exactly the same if each structure cost the same amount. I am not exactly certain that each structure did cost the same amount. This is true since from Exhibit 125, pages 862, 863 and 864, it is apparent that with some minor exceptions all these structures cost the same amount. They were so nearly
966 alike that the cost should be the same except in a few instances where the building might vary slightly from standard.

Turning now to pages 35 and 36, which show Account No. 1011, "Branch Lines to Distributors"; we will take the first one there in Barton County, a lateral, where the condition percent is 95. That refers to a branch pipeline through which deliveries are made to consumers of gas off of the main pipeline system. The percent condition which I have assigned to lateral lines is, in general, based upon

the condition found by examination of the main line itself. In the State of Kansas, as may be noted on page 8 of Exhibit 127, I found that the main line was in 95.72 percent condition. I therefore assigned to the lateral line listed as the Barton County lateral a condition of 95 percent. That Glasco lateral, also in Kansas, was constructed, as I recall it, at a considerably later date than the main line itself. That is my present recollection of that. Considering the condition of the lines, that is of the main line found in this area, I have assigned to the Glasco lateral a condition of 97 percent. It is my judgment that the figure of 95 that I used for the Barton County lateral is justified from my knowledge of the conditions existing on the main line. And it is my judgment that the percent condition of the Barton County lateral is not less than 95 percent. I saw the equipment in Barton County, which constitutes the second item. It consists of some direct meters. There is no deterioration visible from an exterior inspection, except as to the condition of paint on that equipment. I have made an allowance, however, for wear and tear that would not be disclosed upon exterior inspection.

I made the same type of examination of the regulator station, shown under the caption "Glasco", as being in 95 percent condition, as I made of the meter and regulator station in Barton County. That is true as to all of the meter and regulator stations shown on pages 35 and 36.

At the various locations where the tools of Natural Gas Pipeline Company and Texoma, as listed at pages 37 and 63, under Account No. 1013, in Exhibit 127, are kept, at the compressor stations, pipeline warehouses and field warehouses, I have inspected tools and equipment. This consists of the equipment used by the pipeline and compressor station crews for maintenance and repair work. Included in this classification are portable electric lighting units, welding equipment, excavating equipment, and in general the full line of equipment required for pipeline or compressor repair and maintenance. I arrived at the percent condition of these tools and appliances from a price listing of this equipment compiled by Mr. Hamilton's organization. To a price listing of this equipment, I have applied my observations as to the condition of the equipment and have arrived, by that process, at the weighted values of condition in percent as shown on pages 37 and 63 for these classifications.

Cross-Examination Interposed by Mr. Slaff.

I had a listing of these tools and equipment. For the major items, I had specific observations as to their condition. This equipment was priced by Mr. Hamilton's organization at its reproduction cost new. I applied specific observations to those specific items of major equipment. The small hand tools I lumped together.

967 *Direct Examination Resumed by Mr. Hedrick.*

Included within the classification of tools and appliances in this particular item are wrenches, tongs, excavating equipment, welding equipment, and water pumps.

Cross-Examination Interposed by Mr. Slaff.

To the small tools I applied the percentage independently, based upon the general observation as to the condition of small tools. For the major items of equipment I applied specific observations. Those are all weighted out, and from the weighting out I arrived at the overall condition of each group. I applied the same procedure to each one of those three groups of tools. I have, as the result, a different percent condition for each of the three groups.

On page 542 of Exhibit No. 125 are listed tools and appliances in the State of Kansas at three locations. Bloom compressor station, Glasco compressor station, and Heizer compressor station. Of the amount at the Bloom compressor station of $6,483, $2,418 represents equipment, acquired in 1938 and 1939, consisting largely of caterpillar tractors, water pumps, portable electric lighting plants, and similar equipment. To that equipment I have applied an over-all figure of 97 percent, resulting in a deduction of $73 from reproduction cost new. To the balance of the reproduction cost new of that equipment I have applied 75 percent against $4,065, resulting in a deduction for depreciation of $1,016. This is a total deduction for depreciation against that equipment of $1,089. Now to develop the 75 percent figure, I will have to get back further into other detail sheets. For Glasco station in similar fashion, of the total amount shown on page 542 of Exhibit 125 of $7,042, $2,967 was recently acquired equipment,

to which I have assigned a condition of 97 per cent, resulting a deduction of $89. To the balance of $4,075 I applied a condition of 80 percent, resulting in a deduction of $815. For Heizer station, of the total amount shown on page 542 of Exhibit 125, of $13,053, $6,615 was recently acquired equipment, to which I have assigned a condition of 97 percent, resulting in a deduction for depreciation of $198. The balance of the equipment in the amount of $6,438 reproduction cost new has been assigned a condition of 70 percent, resulting in a deduction of $1,931. The total of those deductions for depreciation of tools and appliances in Account 1013 in the State of Kansas is $4,122.

Direct Examination Resumed by Mr. Hedrick.

Referring to pages 37 and 63, showing Account 1014, "General Laboratory Equipment of Natural Gas Pipeline Company of America, and Texoma Natural Gas Company", this equipment includes equipment at the Joliet, Illinois meter station and regular station used for the testing of natural gas and for testing and calibration of measuring instruments. It consists of thermometers, gauges, calorimeters, chemical balances, specific gravity apparatus, gas analysis apparatus, and, in general, equipment of that nature.

I inspected the equipment at location and made specific notes as to the condition of the major items and have weighed those observations out against the prices to Mr. Hamilton's figures of reproduction cost. I did this
968 generally in the same way as I did in the case of other miscellaneous equipment concerning which I testified. I arrived at the figure of 93 percent as a result of that weighting out.

It was a mathematical process of multiplying values by observed conditions. This 93 percent results from the application, for example, to the "apparatus for determination of deviation from Boyle's law" of a figure of observed condition. I applied that condition to the value of the equipment, as fixed by Mr. Hamilton in his sheet for reproduction cost.

Taking other items of equipment in the same fashion, I applied to the values shown in the reproduction cost estimate the figures of condition which I observed, and added both columns, reproduction cost figures and the re-

sultant figures derived by the application of the percent figures, and the ratio of those two sums produces the weighted condition, which in this case would be 93 plus or minus. I have rounded it out at 93 percent. (Motion to strike witness' answer by counsel for Illinois Commerce Commission denied.)

The general laboratory equipment of Texoma, shown at page 63, Account 1014, is of the same character in part as the equipment in the laboratory at Joliet. In addition it contains equipment for the testing of petroleum products. This latter equipment is locted at the gasoline plant at Fritch. I arrived at the percent condition of 90 shown on page 63 just as I arrived at the percent condition of equipment shown on page 37.

Account No. 1015, "Automotive and Transportation Equipment," includes automobiles, trucks, tractors, and trailers. The percent condition assigned to this equipment was arrived at from a consideration of the mileage which the various pieces of equipment had recorded up to June 1, 1939. I gave consideration to the fact that cars used by Texoma were largely used in the Panhandle field, where roads were poor, or non-existent, and where the effect of mileage upon the condition of that class of equipment is greater than is the same amount of mileage upon cars used further north on this system where roads are better. There is not nearly so much dust on the north end of the line as on the the south end. The dust condition tapers down to almost nothing as you proceed northward. I took that factor into consideration in arriving at the percent condition of this equipment. In arriving at the percent condition of automobiles, I estimated that an automobile in the field system of Texoma which had traveled 25,000 miles to be depreciated approximately one-third. An automobile with the same mileage on the system of Natural Gas Pipeline Company of America, I estimated had depreciated approximately 25 percent. The company records were available to me so that I could determine the mileage on this transportation and automobile equipment. I have seen trucks that had more than 50,000 miles on them, and I think I have some observations on cars that have exceeded that.

Cross-Examination Interposed by Mr. Slaff.

969 If I had a car which showed exactly 25,000 miles of mileage I would give it a percent condition of 66.66. In applying the conditions I took into consideration the mileage on the basis I have explained but have used them all as event percentages without fractions. If it was 12,500 miles, I used half of 33⅓ percent or 16⅔ percent. The basis upon which I arrived at the relationship between mileage and percent condition was that in general the cars on the Texoma system can be exchanged on the basis of a full life rating of 75,000 miles, and on the Natural Gas Pipeline Company of America system they can be exchanged on the basis of a full life of 100,000 miles. That is, if they had about 50,000 miles they can be turned in at approximately 50 percent of cost.

Direct Examination Resumed by Mr. Hedricks

Account No. 1016 for Natural Gas Pipeline Company consists of the office furniture and fixtures, calculating machines, typewriters, and so forth, at the compressor stations and at the warehouses on the pipeline sysiem. In the State of Illinois, the same class of equipment is found at the Joliet meter and regulator station and in the Chicago office. I arrived at the percent condition of that office equipment, furniture and fixtures, by weighing my observations against the reproduction cost new of Mr. Hamilton in the same manner I have described for other equipment where different classes of equipment were carried under the same Account number. The resultant figures have been rounded off to even percentages. In the case of Texoma that equipment shown of page 64 consists of the furniture and fixtures at the Fritch gasoline plant, Fritch compressor station, the Dumas warehouse, Kingsmill warehouse, and at the operating office of the company in Amarillo. I inspected the equipment in each one of these locations, in each office, and upon my first inspection when I did not have available any inventory. I listed the equipment as I inspected it. Upon the second inspection, I had that listing available and went over it again. Now I have seen, I think, every bit of this equipment, except a few minor and unimportant items that I may have overlooked in going through the various offices.

I did not see all of the wells of Texoma Natural Gas Company. I really do not know how many I saw. I made specific notations as to 41 but I saw a great many other wells on which I did not make specific notations. There were probably 25 of these additional wells. I actually saw all of the wells on which I made notations. The company records as to all of these wells were made available to me. These records show the equipment in the well, its age and the work that has been done upon it. So far as an examination of these wells is concerned, very little deterioration is disclosed. Of course, in an examination of the well from the surface, only the top fittings are visible. If a well is in very bad shape that can sometimes be detected by leakage showing up at the surface. Nothing of that sort was visible in connection with any wells which I saw. I have determined the amount to be deducted for depreciation for these wells on the basis of age of wells.

To wells drilled in 1938 and 1939 I have assigned a condition of 100 percent. To wells drilled in 1936 and 1937 I have assigned the condition of 98 percent. To wells in 1934 and 1935, I have assigned the condition of 96 percent. To wells drilled in the years 1930 to 1933, inclusive, I have assigned the condition of 95 percent. To wells drilled prior to 1930, I have assigned the condition of 92½ percent,
970 with the exception of a few very old wells drilled about 1926 and 1927, to which I have assigned a somewhat lower percent condition, and with the exception of a group of wells in Gray and Carson Counties connected to lines other than those of Texoma Natural Gas Company to which I have assigned the condition of 50 percent. This latter assignment is based upon information which has been made available to me as to the condition of those wells below ground. There are four of those wells: G. H. Saunders, Nos. 6, 10, 12, and 13, which fall under this 50 percent classification. There are others, the M. A. Shaw well, and another is the McLarty-Lester "B" well No. 3. Based on my experience and the information which I obtained concerning these wells, it is my judgment that the percent condition of each of these wells is as is set out on pages 41 to 54 of my exhibit.

Account No. 1007, beginning on page 57, shows the equipment in the gasoline plant at Fritch. I have made two inspections of this gasoline plant, the equipment of which is listed in Exhibit 127 under Account 1007. Upon each of

these inspections I have noted the condition of the various items of equipment and have applied those observations against the cost of reproduction new provided by Mr. Hamilton. In the case of major structures, such as, for example, the boiler house on page 57, the figure of percent condition of 94.31 is a weighted figure, arrived at by multiplying my observations to component parts of this structure to arrive at the overall condition. The majority, however, of the figures in this column of condition percent under this classification are direct observations of the overall condition of the items to which they are applied. I have applied separate observations as to conditions to the following divisions of the reproduction cost estimate of Mr. Hamilton for this structure: The superstructure, the foundations, the floors, the stairways, down-spouts and gutters, lighting, plumbing, partitions, ventilators. Those divisions of that building will be found in Exhibit 125 on pages 797 and 798.

Account 1012 shows a list of the drilling and clean-out tools of Texoma. I saw some of this equipment at the Dumas warehouse and some at Kingsmill warehouse. I saw some of it in use upon a well. My observation of this equipment indicates that it had lost about 30 percent of its value, so I assigned to it a condition of 70 percent overall. I did not go into any specific detail as to individual items of tools. I simply assigned an overall condition to this group of equipment.

At page 64, Account No. 1024, appears a list of the booster station equipment of Texoma. That is the small 40 horsepower unit about which other witnesses have testified. It was practically new and just broken in on June 1, 1939, and I assigned to it and the miscellaneous equipment, piping, and the building at that station, a 100 percent condition.

From my experience in the natural gas business, and in conducting investigations to determine the condition of natural gas properties about which I have testified, and from my inspection of these properties and from the original records and information with which I have been supplied, it is my judgment that the percent condition for each of the items listed in Exhibit 127 is as set out opposite each one of these items. And it is my judgment that the depreciation which should be deducted from reproduction cost new, is

the amount set out opposite each one of those items
971 and shown in the third column in Exhibit No. 127. I furnished the figures shown in the third column of Exhibit 127 to Mr. F. C. Hamilton and men working under him for the preparation of Exhibit 125, and they have used those figures in the last two-named exhibits.

Cross-Examination Interposed by Mr. Slaff.

I have checked each figure in Exhibit 125, on each one of the pages in which my figures, developed and shown in Exhibit 127, are used. The figures under the column "Depreciation Deducted" in Exhibit 127 were furnished to Mr. Hamilton and his organization and were used by them in their Exhibit 125. I have verified that they so used them by checking them myself or having my organization check them.

Direct Examination Resumed by Mr. Hedrick.

I may say that with respect to lands and rights-of-way, there being no deductions, I furnished them the zero figures which Mr. Hamilton used for that zero deduction.

My examination showed that the program of maintenance and operation of this natuarl gas system had kept it in a better state of preservation, in a better of state of maintenance, than any other system with which I ever had any experience. The facilities for accomplishing this have been so carefully thought out and provided for in advance, and the standards have been set so high, that the results are very unusual in comparison with what you find even in the best of other pipeline systems of which I have knowledge, and I am familiar with most of the major gas pipeline systems of this country.

(At this point Exhibit No. 128, the map showing the location of the holes at which the pipeline was inspected, was offered in evidence and received without objection.)

I have checked that exhibit against the actual facts. It was prepared at my direction, has been approved, and it bears my signature in the lower right hand corner of the map.

Cross-Examination by Mr. Booth.

My work has had to do with determining the amount which should be deducted from the reproduction cost new on account of the existing depreciation which I found in the property, shown in my Exhibit 127. This exhibit does not embrace all of the property of these two companies. It does not show the leaseholds and it does not show the undistributed or general construction costs. I made a study of what purported to be the original cost of the companies' property. I made no investigation of their records however to determine the original cost. I had nothing to do with the preparation of Exhibit 125 other than to submit to Mr. Hamilton and his associates the amounts which I determined to represent the existing depreciation, as I have already testified. I had nothing whatever to do with the determination of the reproduction cost new of these companies' properties.

972 Mr. Hamilton and his associates had nothing to do with the preparation of Exhibit 127 other than to supply me with the figures of reproduction cost from his Exhibit 125, with the exception that some of Mr. Hamilton's employees did perform some of the mechanical operations of multiplication, addition and division for me. (Motion to strike witness' testimony and portions of Exhibit 127 by counsel for the two Commissions denied.)

EXHIBIT NO. 127 was offered and received in evidence over objections of counsel for each of the two Commissions, to whom the Examiner granted exceptions. (Objection to Exhibit 125 by counsel for the two Commissions overruled.)

SEPTEMBER 6, 1939

(Exhibit No. 126 for indentification, withdrawn by counsel for defendants.

EXHIBIT NO. 124 for indentification, received in evidence without objection.

EXHIBIT NO. 125 for identification, except the two items captioned "Lands in Fee" and "Rights of Way," offered and received in evidence over objections of counsel for each of the two Commissions, to whom the Examiner granted exceptions. The ruling as to the two above-mentioned items of the exhibit was reserved pending further testimony.)